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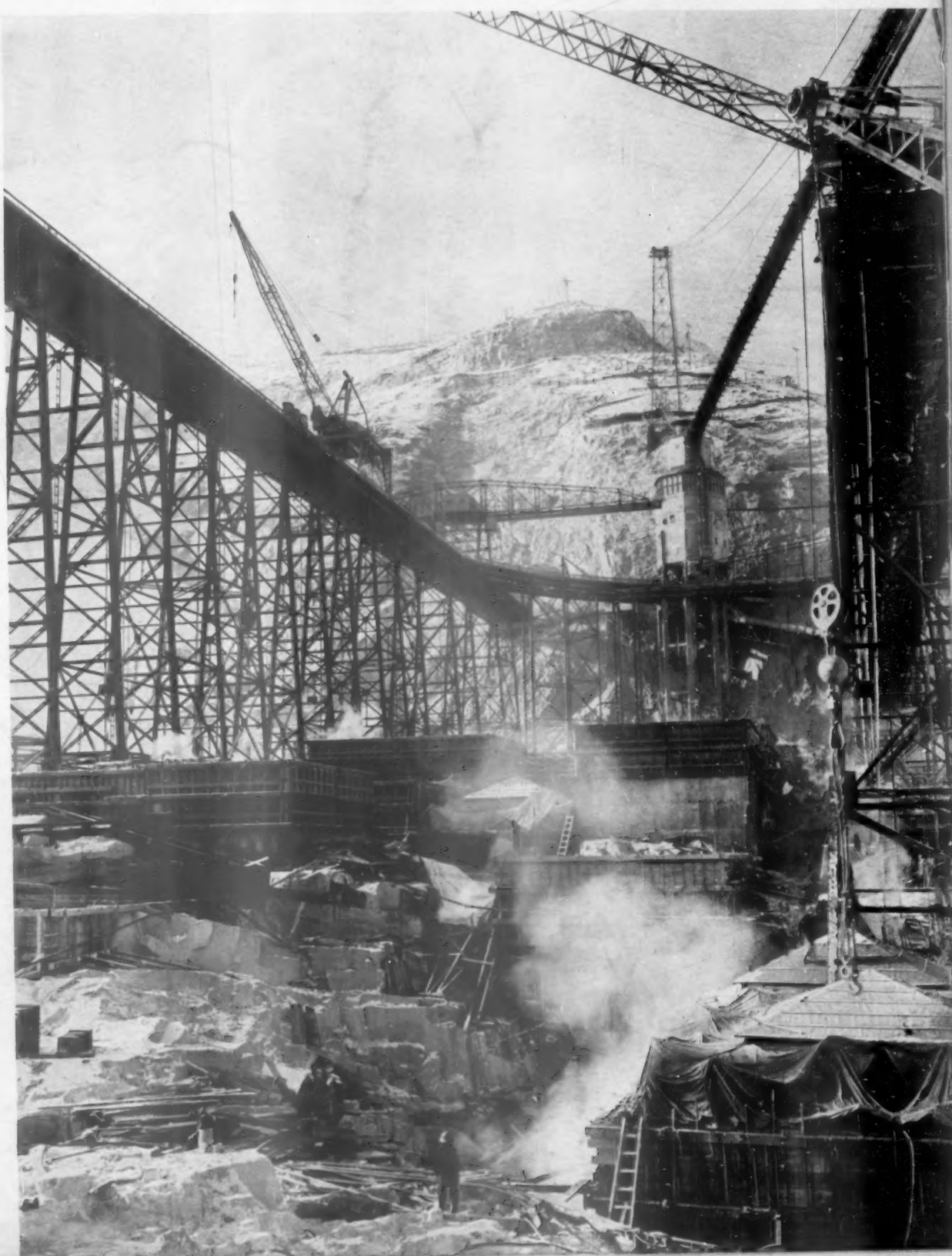

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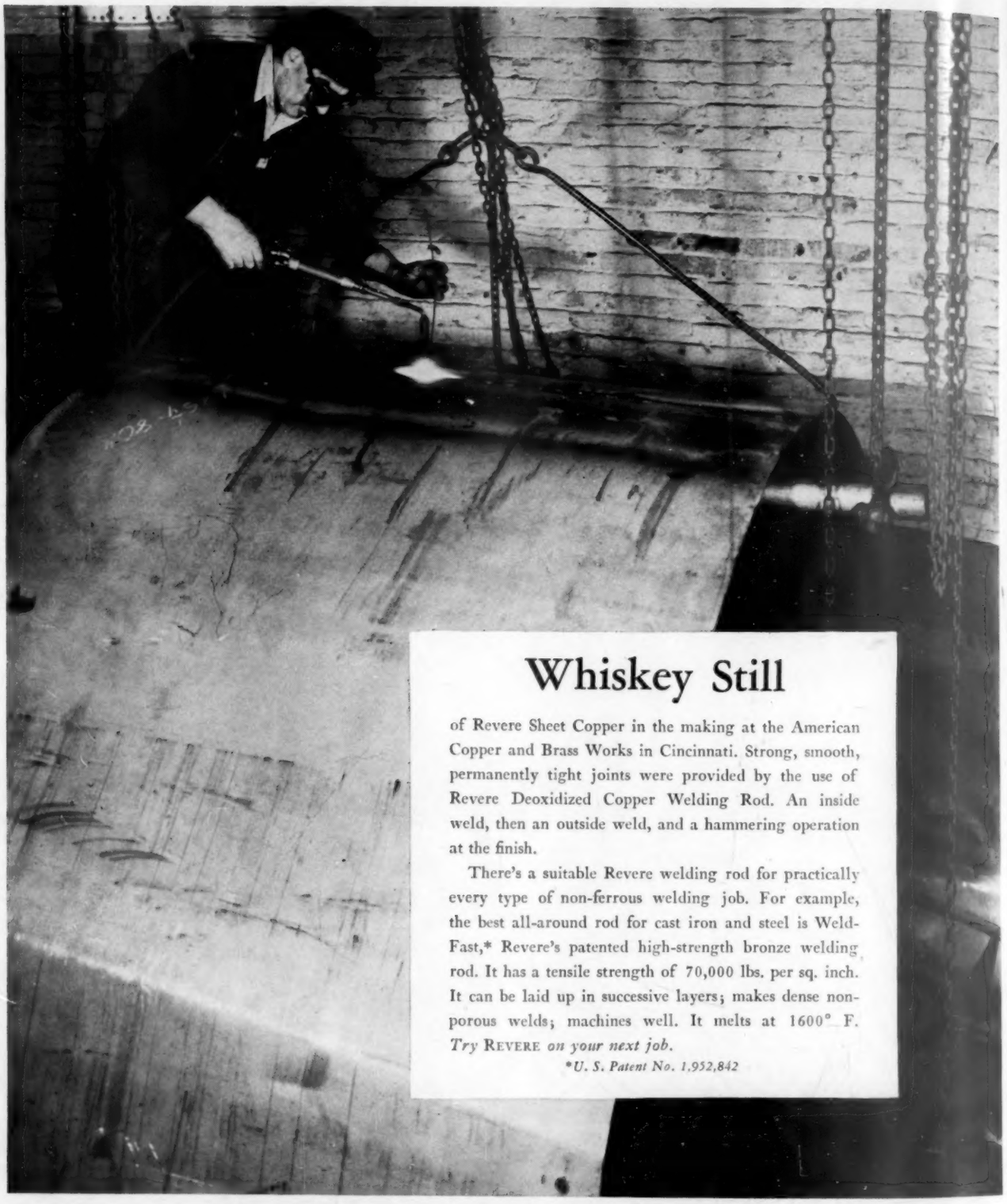

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There's a suitable Revere welding rod for practically every type of non-ferrous welding job. For example, the best all-around rod for cast iron and steel is Weld-Fast,* Revere's patented high-strength bronze welding rod. It has a tensile strength of 70,000 lbs. per sq. inch. It can be laid up in successive layers; makes dense non-porous welds; machines well. It melts at 1600° F. *Try* REVERE *on your next job.*

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THE WELDING ENGINEER

Vol. 21, No. 6 JUNE, 1936

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G. H. MACKENZIE, *President and Treasurer*
F. L. SPANGLER, *Editor* L. C. MONROE, *Advertising Manager*

Representatives

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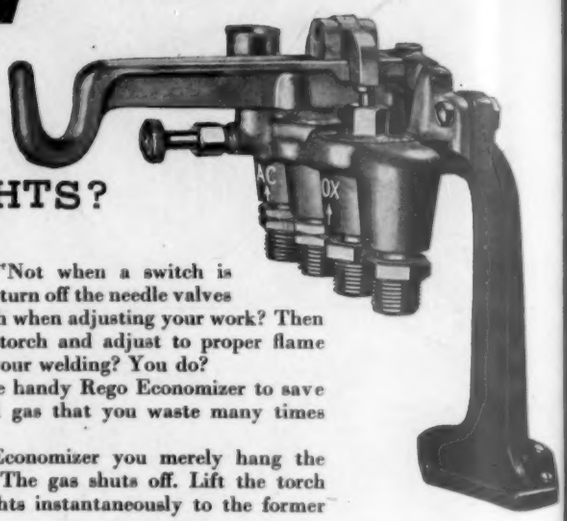
DO YOU UNSCREW THE BULBS . . .

WHEN YOU TURN OUT THE LIGHTS?



"No," you say, "Not when a switch is handy." But, do you turn off the needle valves on your welding torch when adjusting your work? Then do you re-light the torch and adjust to proper flame when you continue your welding? You do?

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EDITORIAL

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Restrictions Promote Extra-Legal Welding

● Regulations against welding are often their own poison. They emphasize the desirability of welding by forcing inconveniences and high costs upon those denied certain of the advantages of the process.

The beneficiaries of welding are not alone the makers and sellers of welding equipment and supplies, or the direct users of welding, but also every individual who rides in any sort of vehicle, who enjoys the advantages of refrigeration or air conditioning, who uses coal or concrete aggregate quarried from the earth, who makes any use of power generated by a head of water or of steam. In short, virtually every individual is a beneficiary of welding.

Therefore, everybody has something at stake in codes or regulations affecting the use of welding.

Those few who decry the very thought of entrusting life and property to welded connections would be rudely startled should they find that perhaps the very concourse or bridge that they use day after day is welded at least in part, or that their office floor is supported by welded connections—hidden, but nonetheless real.

Such a picture came true to life recently, when an opponent of welded structures, after expressing his horror at the thought of using welding in public buildings, was told that he was then and there standing almost directly over some welded beam connections.

Where necessity demands welding, codes and regulations that stand in the way are often neatly sidestepped—and it will always be so. Of course, welding done contrary to prescribed codes is not talked about openly. But lots of it is done, and more is going to be done, until such time that regulatory bodies see the need for removing such unwarranted restrictions.

Those members of code bodies who oppose welded structural connections should be challenged to solve some of the many problems involving modernization or extension of steel-frame buildings. Denying themselves the use of welding, they will be in a quandary to find answers to many such problems. Welding is often necessary for any workable solution.

Despite the out-moded building codes, hundreds of lives and many thousands of dollars worth of property are entrusted to welded connections in buildings in our metropolitan centers. But such extra-legal uses of welding must await a more receptive attitude on the part of authorities before being brought to light.

They Pick on ME *to* GIVE AWAY THE BRIDE

by NICK RODDER

WHY DO women want to get married, and why do they pick out June, and why does the Missus pick on me? . . . I asked myself a few days ago. Her sister Julia is stepping out with an otherwise nice young welder name of Tomkins, and they're all-bent to have me give away the bride. Me, I'm more at home in a welding helmet than I am in dude clothes and so I don't feel too bad when a good customer of ours asks for help with some Nickel pipe lines.

This shows the 90° and 180° 2" Tube Turns (.078" wall) gas welded to 2" O.D.-.078" cold-drawn seamless Nickel tubing. You can see what a nice flat weld and good reinforcement we get on the job. The "turns" are made by Tube Turns, Inc., Louisville, Ky., the town which is also noted for its Derby and its Bourbon likker.

They are 2" and 3" O.D. Pure Nickel tubing with wall thicknesses of about .078" and .093". This is an alkali manufacturer, and heavier piping isn't needed on account of we can weld good butt joints on light wall tubing, and so the liquid flows easy through the smooth insides.

Another thing, on these light gauge Nickel pipe lines we use "Tube Turns" instead of cast fittings. They weld okay because Tube Turns are same gauge and diameter as the piping. They're made seamless, hot formed into 90° and 180° bends.

The photos, which a guy from the office made, show what slick work we did on this job. There isn't really any trick to it. First you take your tubing that you're going to weld, or your straight tubing and Tube Turn. You tack weld the two opposite sides, leaving a small uniform space between the two edges of the joint. Then, on this job, I pick out No. 41 Nickel Gas Welding Rod, and don't use any flux.

I'm careful to tune the whine out of my flame tip, using just enough extra gas to show about a 1/16" feather. That's a reducing flame. You can see what a nice flat weld I get, and where the tube is cut away it shows we sure get good penetration and normal reinforcement.

Looks bad for Julia

Well, from alkali to soap is only a step, and from soap to dishwashing is another—which is something for Julia to think about. However I just get the boys on the alkali job to where they're welding that pipe line like nobody's business when the Boss wires, "See Blank Dishwasher Company and see if everything's okay."

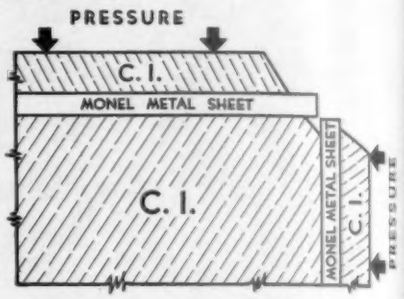
Well, I cheers to myself, there goes the bride without nobody to give her away. This is a swell shop, making dishwashers for hotels and big restaurants and such. And being in the business for good, they make their machines out of welded Monel Metal.

The boss of this shop he rigs himself up a cast iron jig clamp to help the boys handle the gas weld between the large sides of the washer and its top. The cast iron clamp supports the inside corner, and then outside clamps close in and hold the sheets from the outside

You couldn't find that weld with a magnifying glass.

like I made a sketch of it for you.

He paints a paste made of Monel gas welding flux on both the inside and outside of the Monel Metal sheet and



Here's the sketch of the jig that makes joints hard to find.

a little on the No. 40 Monel Gas Welding Rod. Then he uses a slight reducing flame and starts to gas weld at one end and keeps on all the way around the corner. Only enough weld metal is used to provide a minimum to be ground off. But the welder is a smart egg who knows his groceries, and he gets a good penetration into the *inside* corner, which reinforces and stiffens it.

The jig, being as it's cast iron, absorbs heat and holds the Monel Metal sheets in line, so there's not a sign of a buckle in the finished job. The joint is then ground and polished, and after the boys get through with their buffers and lapping wheels, you can't even find it. Which is exactly what happens to me at that wedding!

Nick Rodder

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INCO WELDING RODS and FLUXES

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Metallic Arc . . . No. 31 INCO Nickel Metallic Arc Welding Wire.
Carbon Arc . . . No. 21 INCO Nickel Carbon Arc Welding Wire.

***for* MONEL METAL**

Oxy-Acetylene . . . No. 40 Monel Gas Welding Wire. For flux see * at right.
Oxy-Acetylene . . . No. 43 Silicon Monel Gas Welding Wire.
Metallic Arc . . . No. 130 INCO Monel Metal Arc Welding Wire.
Carbon Arc . . . No. 20 INCO Monel Carbon Arc Welding Wire.

***for* INCONEL**

Oxy-Acetylene . . . No. 42 Inconel Gas Welding Wire. For flux see ** at right.
Metallic Arc . . . No. 32 Inconel Metallic Arc Welding Wire.

***for* NICKEL-CLAD STEEL**
(for welding of Nickel side)

Oxy-Acetylene . . . No. 41 Nickel Gas Welding Wire.
Metallic Arc . . . No. 35 INCO Nickel Metallic Arc Welding Wire.
Carbon Arc . . . No. 21 INCO Nickel Carbon Arc Welding Wire.

FLUXES

* INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

INCO welding materials as listed can most conveniently be obtained through regular INCO distributors.
Detailed welding instructions furnished on request.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

The Welding Engineer

VOLUME XXI | JUNE, 1936 | NUMBER 6

SPRAYED STAINLESS STEEL Resists WEAR And CORROSION Under TRYING CONDITIONS . . .

By WILLIAM C. REID

Metallizing Engineering Co., Inc.

THE ability of sprayed stainless steel to give a long-wearing surface in addition to providing a surface which will effectively combat corrosion, adapts it ideally to the building up of parts operating under severe conditions of service and parts which come in contact with food products.

Two types of stainless steel are in general use for spraying. They are the ordinary 18-8 and a special air-hardening stainless steel. The first is used where corrosion alone must be combated, and the latter on parts which are subject to severe abrasion as well as corrosion. The air-hardening stainless combines the advantages of corrosion resistance and an extremely hard surface, which is, in effect, a stainless case-hardened surface.

4-Ft. Stainless-Sprayed Bowl

(This bowl from a milk-bottling machine, 4 ft. in diameter and 1 ft. deep, was heavily blasted with No. 30 angular steel grit, and built up by "metallizing" with 18-8 stainless steel to an average thickness of 0.040 in., after which it was polished by means of rotating emery discs, followed by the usual application of buffing wheels. In this particular application, the use of a high-capacity spray gun permitted the metal to be deposited with extreme rapidity and with unusual density. Thus, in this particular instance, previous objections on the grounds of cost were eliminated.)

Building Up Hot-Oil Pump Plunger With Air-Hardening Stainless Steel

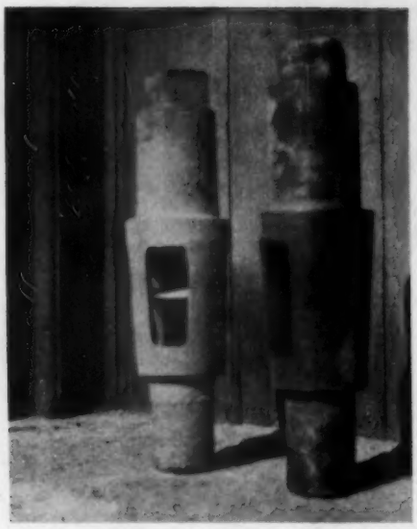
(The plunger is 4 in. in diameter and 40 in. long, and is being built up on the bearing surface which passes through the packing gland. The actual length of the surface "metalized" in this instance is 24 in. The surface was prepared by undercutting 1/16 in. on the diameter with a rough, tearing cut, and was built up 0.020 in. oversize to allow for grinding stock. After finish-grinding, the surface scleroscoped 70.)

Many Hot-Oil Pump Shafts Are Sprayed With Stainless Steel

There are now in operation hundreds of pump shafts used in the oil industry, which have been built up with air-hardening stainless steel. These pump shafts are used in hot-oil pumps, and the "metallized" surface must withstand abrasion as well as corrosion. Here, the condition is unusually severe, as these shafts operate under high temperature and high pressure, and when shut down are subject to reasonably severe atmospheric corrosion, as in many instances they are located in the open.

Generally speaking, there has been considerable controversial opinion in regard to the efficacy of sprayed stainless steel, the question being whether or not stainless steel possesses the same characteristics after spraying that it did before. Exhaustive tests over a long period of time have indicated definitely that the corrosion-resisting qualities of sprayed stainless steel are definitely a function of the finish; in short, the finer the finish, the more effective the protection provided. It follows, therefore, that all parts such as pump plungers, plug valves, and cylindrical objects that are finish-ground, possess excellent corrosion resistance, and in the instances where such parts run in metallic packing, the polishing effect and consequent high luster steadily improves its resistant qualities. Such parts, after submission to salt-spray tests, in direct comparison with solid material of the same analysis, have produced identical results.

Therefore, articles such as the milk



Worn Valves Built Up With Stainless Steel

(These two tapered plug valves, used in hot-oil lines, have been built up by spraying with air-hardening stainless steel on the worn tapered surface. This is an application that has tremendous possibilities, and has in the past given extremely satisfactory service. Besides air-hardening stainless steel, gratifying results have also been had with monel metal, 18-8, and, in some instances, pure nickel.)

bowl illustrated must be polished. This should give rise to no serious objection to the use of the "metallizing" process, due to the fact that all such articles must be polished before they can be used, regardless of whether they consist of solid or sprayed stainless steel.

No Corrosion Evident After 90-Hour Salt-Spray Test

The following is a description of an actual comparative test: Samples "metallized" with stainless steel were submitted to a 15% brine solution in the form of a salt spray, to determine the effectiveness of a coating of this type in combating corrosion. The results obtained from this test show that the coating in the rough state provides little or no protection. In other words, rust became evident on the surface after a few hours of exposure. Samples "metallized" with stainless steel, and then rough-ground, were submitted to the same test at the same time. These stood up for a considerable period before rusting became evident. Additional samples "metallized" with stainless steel and then polished, passed through a 90-hour exposure in the salt-spray without evident rust, and demonstrated resistance equal to that of rolled stainless steel.

Chemical tests have been applied to "metallized" stainless-steel coatings in an effort to determine whether or not any of the protective elements are burned out during spraying. These tests proved conclusively that the nickel and chromium contents of sprayed stainless steel remain substantially the same, and that the addition of carbon is inconsequential.

Welding Society Sections Elect Officers

Recent elections held by the Cleveland, New York, Philadelphia and Chicago Sections of the American Welding Society resulted in the following officers to serve in their respective Sections for the ensuing year:

Cleveland: chairman, R. P. Tarbell, welding engineer, The Imperial Electric Co., Akron, O.; vice-chairman, Wm. G. Wehr, general superintendent, The Cleveland Crane & Engineering Co.; and secretary and treasurer, E. T. Scott, president, The Cleveland School of Welding.

New York: chairman, C. W. Bryan, Jr., Federal Shipbuilding & Dry Dock Co., Kearny, N. J.; first vice-chairman, R. W. Boggs, The Linde Air Products Co.; second vice-chairman, J. L. Edwards, H. G. Balcom & Associates; and secretary-treasurer, A. F. Keogh, Sound Welding Co.

Philadelphia: chairman, C. I. MacGuffie, General Electric Co.; vice-chairman, T. M. Jackson, Sun Shipbuilding & Dry Dock Co.; treasurer, R. D. Thomas, R. D. Thomas & Co.; and secretary, H. E. Hopkins, R. D. Thomas & Co.

Chicago: chairman, Albert Reichmann, vice-president, American Bridge Co.; vice-chairman, Tom Jones, welding superintendent, Carnegie-Illinois Steel Co.; secretary and treasurer, F. L. Spangler, *The Welding Engineer*. Directors for three years: J. Kinsock, Standard Oil Co.; Leslie S. McPhee, Whiting Corp.; G. E. Tenney, The Lincoln Electric Co.; and D. C. Wright, Sears, Roebuck & Co. Director for one year (to fill vacancy), A. M. Candy, Hollup Corp. Director to represent Section at New York meetings, C. J. McGregor, American Steel & Wire Co. Chairman of Program Committee, W. B. Browning, The Linde Air Products Co. Chairman of Membership Committee, H. C. Boardman, Chicago Bridge & Iron Works.

New Welding Schools in Middle West

Several welding schools have recently opened in Chicago and Peoria, Ill. Two new Chicago schools are the Metals Maintenance Corp., at 9207 S. Western Ave., where instruction is being given in both arc and gas welding and in metal spraying, with lecture work in metallurgy, and the South Side Welding School, at 741 West 70th St., giving courses in arc and gas welding and metallurgy.

Three new welding schools opening in Peoria are the Caskey Welding School at 137 W. Washington St., East Peoria, The Acme School, in the 3300 block on N. Adams St., and the Standard Welding School, at 314 Fayette St.

Dravo Co. Building Welded Barges for Stock Purposes

In anticipation for increased demand for inland waterway craft, the Dravo Contracting Co., of Pittsburgh, Pa., continues to build a large number of all-welded barges for stock purposes. In process of construction at the present time are 15 welded "W 2" coal barges, 175x26x10.8 ft., comprising 7,080 tons of steel; four welded flush-deck cargo box barges, each 100x26x6.6 ft., involving 660 tons, and other equipment.

Low-Cost Crossing Repair Made With Applicator Bars

In the repair of manganese-steel railroad crossings, the use of applicator bars speeds up the work and reduces costs, it is claimed. The illustrations show a crossing with some of the steel cut out, ready for welding, a layer of "Manganal" applicator bars welded in place, and a second layer welded on top of and crosswise to the first layer. In this manner the repair is built up to the proper height with the minimum of weld metal deposited.

These bars are made of nickel-manganese steel, and have all the desirable characteristics of the parent metal. They are available in various shapes, and their use cuts down materially the amount of welding required.

Making Repair In Manganese Crossings

(Showing hole cut in crossing preparatory to welding, first layer of applicator bars welded in place, and in bottom view, second layer of bars welded on top of first.)

Rotary Tilting Table in 45 Degree Position

Adjustable Welding Tables Speed Watercraft Building

By EDWARD H. SYKES
Pittsburgh Correspondent,
The Welding Engineer

The growing importance of the use of welded floating equipment for inland waterway service, in both propelled and non-propelled vessels, continues to be reflected in the large number of specifications being received for this type of equipment by boat and barge builders in the Pittsburgh District. The large welding fabricators in the Pittsburgh area are busier today than at any time since the colossal collapse of business in the fall of 1929.

The size and nature of propelled as well as towed craft has placed a pressing problem on these large fabricators of welded equipment, for buyers today are considering the speed with which orders can be expedited in the selection of suppliers.

From the standpoint of welded tonnage for inland waterway service, the Dravo Contracting Co., of Pittsburgh, is one of the largest fabricators; and in order to handle efficiently the manufacture of huge river craft, this company has found it advantageous in many ways to develop its own positioning equipment for speeding up production in its shop.

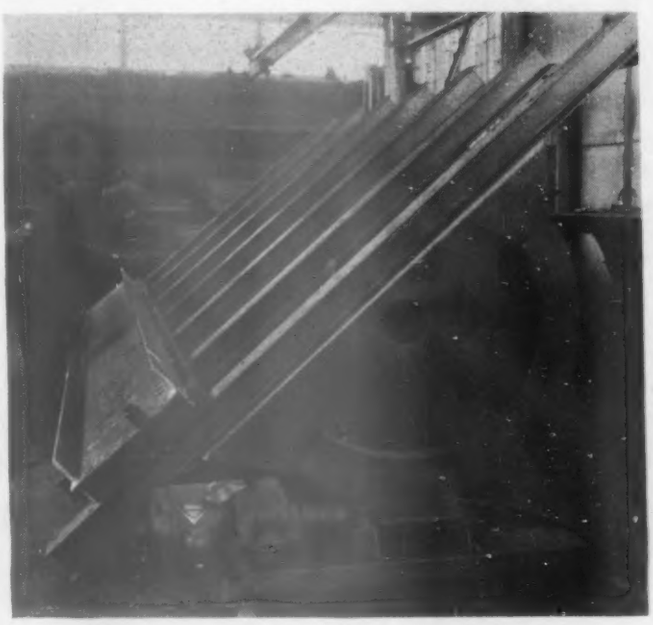
The accompanying illustrations show the variable-position welding tables which the Dravo organization employs in the handling of many of these large welded units. They were designed in the company's own drafting department and built by Dravo engineers.

"We find that these tilting and rotary tables form a very necessary part of our manufacturing scheme wherein we employ extensive and accurate shop fabrication, as well as in the preparation of various sub-assemblies," said Stuart D. Brown, sales manager of the Dravo Company.

"The length and width of the machines, as well as the maximum degree of the tilting or rotating, should be carefully taken into consideration and the machines designed to suit individual shop fabrication schemes.

"There is considerable advantage in manipulating the work in position where the operator can progress with greatest speed and produce the best weld. These machines assist us a great deal in this respect and would, no doubt, be very advantageous for any number of similar fabricating shops."

Some idea of the extensive operations of this large organization may be gleaned from the gross tonnage of non-propelled vessels built in the United States in 1935, principally in boat yards located on the upper Ohio River, in the Pittsburgh district. Of the 305 pieces with a gross tonnage of 86,495 constructed last year, the Dravo Contracting Co. led the field with 15,439 tons, represented by 35 pieces, accounting for nearly 20% of the business.



Variable Position Welding Table.

A. S. T. M. Symposium on Radiography

A Symposium on Radiography and X-Ray Diffraction Methods will be held during the annual meeting of the American Society for Testing Materials, at Atlantic City, N. J., June 29 to July 3. All sessions will be held in the Chalfonte-Haddon Hall.

A paper on "Application of Radiography to the Welding Art," by J. C. Hodge, of The Babcock & Wilcox Co., will be given on the afternoon of June 30, and in the evening of the same day H. H. Lester, of the Watertown Arsenal, will give a paper on "The Problems of Radiographic Inspection," and N. L. Mochel, of the Westinghouse Electric & Manufacturing Co., will discuss "Gamma-Ray Radiography and Its Relation to X-Ray Radiography."

Welded River Craft in Pittsburgh District

The first of an order of three steel improved coal barges of the all-welded type has been delivered by the Dravo Contracting Co., of Pittsburgh, Pa., to O. F. Shearer, of Cincinnati, for the Kanawha River trade. The barges are each 175 ft. long, 26 ft. wide and 11 ft. deep.

The Dravo Company has also completed the construction of a fleet of four open barges of the welded type for the Union Barge Line of Pittsburgh for use in the movement of freight between Pittsburgh and Mississippi River cities. Delivery is also being made of three coal barges to the Campbell Transportation Co., of Pittsburgh, these being of the improved 175-ft. all-welded type, and plates have been laid for three fuel flats for the same concern. The latter, of welded construction, are 125 ft. long, 26 ft. wide and 8 ft. deep.

GRAND COULEE Construction Work SPEEDED With Use of WELDING and CUTTING . . .

By HENRY W. YOUNG

SCATTERED over an area roughly three miles across, surrounding Grand Coulee Dam, is the greatest aggregation of machinery, material-handling equipment and concrete-mixing and pouring apparatus that has ever been brought together for one construction job.

And it is safe to say that were not welding available, the cost of using and repairing this apparatus would be so prohibitively high and the time required would be so long as to make a substantial change in the cost of building the great dam—a structure asserted to exceed as an engineering undertaking the Grand Pyramid of Egypt.

To cover the welding and cutting operations that have been going on for the past two years would be quite impossible within the limits of a single article, because the complexion of the work is constantly changing.

While there are still a great number of shovels, tractors and trucks on the job, the intensive phase of excavating work is past, and with the ending of this phase there was a lessening of the necessity to keep scores of welders constantly busy on shovel teeth, dipper shells, gears, crawler grousers, etc., not only in the shop but on "ambulance calls."

Mammoth Steel Cofferdam Welded Completely Tight

Complete also is the mammoth steel-celled cofferdam which was welded up tight with the electric arc, and on which at one time 90 burners were engaged in trimming off the tops of piles to an even height.

Fig. 2. Cutting Shapes.

(This is a single-torch, automatic machine, operating with a template. It is kept busy most of the time.)

Much welding fabrication has been carried on at all stages, such as grizzlies, bases for hoists, chutes and hoppers for the gravel-plant screen house, cement expansion tank for the east-side mixer, etc.

A pipe-line more than a mile long, 11 in. in diameter and with ½-in. walls, had to be welded together for transporting cement under air pressure from the distant cement storage. And on top of these special jobs came constant repairs of every conceivable nature, from those on the heaviest machinery to engineer's tapes and rules.

At present the shop, where much of the work is brought, is the center of interest to the visiting welder. This shop is in charge of Myron M. Cole, welding superintendent for the M-W-A-K Company, which is building the Grand Coulee Dam, and fifty welders and helpers are under Mr. Cole's supervision at present.

The shop is a building 50x60 ft., adjoining which is a fabricating platform in the open, this being served by a 5-ton crane of its own, also by the machine shop crane and by truck.

A general idea of the magnitude of the operations may be had from the following list of shop and portable equipment: 6 portable welding machines (300 and 400 amperes); 7 stationary welding machines, four of these being in the shop and one each at the screen house and east side and west side mixing plants; about 40 cutting torches and approximately 25 combination torches; one shape-cutting machine; one 10-tank oxygen manifold at shop; one 4-tank oxygen manifold at screen house; one 500-lb. acetylene generator at shop; and one 150-lb. acetylene generator at screen house.

Consumes 1,000 Lb. of Welding Rods Per Week

Practically every kind of welding rod is stocked, and at the present operating stage approximately 1,000 lb. of rod is used per week.

While browsing around the shop with this writer, Mr. Cole pointed out some of the work that was going through at the time, and the accompanying photographs, taken at random, represent part of it.

Photograph 1 shows an interesting piece of work. The snub pulley on a 48-in. conveyor had met with an accident. Every spoke had been broken out and it had arrived at the shop a "mere shell of its former self."

Fig. 1. Bronze-Welding a Pulley.

(A fabricated plate is being brazed at each end of the shell to replace the spokes, which had broken out.)

Here is the rim, set up on the platform. A 1¼-in. fabricated plate is being brazed or bronze-welded in each end to take the place of spokes, like heading up a barrel. In holes in the two end-plates, the shaft and hubs will then be set up and welded. The pulley will then be as good as new. Mild steel will be used for this welding.

In Photograph 2 is seen the shape-cutting machine mentioned in the tabulation of equipment. This has been erected in the open and is in almost constant use on fabrication work of one kind or another. It is a large single-torch automatic machine, with template, and capable of cutting ½- to 6-in. steel.

Photograph 3 shows a small collection of what comprises one of the "favorite pastimes" around the shop—bucket teeth. The neatly rounded off snags shown at the left come in at an average rate of about 50 a day.

Arc-Welder Does Dental Work On Worn Bucket Teeth

These must first be rebuilt with stainless steel and then hard-surfaced, as shown at the right. "Now that the shovels are working in rock, the buckets seem to be constantly teething," said Mr. Cole, "and the arc-welding machine apparently is the only form of pacifier that will keep them contented."

So many economies are effected by welding on a construction job of this nature, that they could scarcely be enumerated. As a typical example, they have begun to fabricate radiator shells for White trucks in this shop, and have done 10, complete in every detail, down to the name "White" written with stainless-steel electrodes.

Fig. 3. The Boss Welder, M. H. Cole.
("The shovels," he says "are always teething, and the arc-welder is the only thing that keeps them pacified.")

Fig. 4. Slicing Steel Piling on Abandoned Work.
(This was the wall of a ramp no longer in use. It was overturned, and is being cut into sections with the torch. Imagine what a task this would be *without* a torch!)

Rocks are forever bouncing off the cabs of trucks onto the radiator shells and cracking them, for they are made of cast aluminum. These shells cost about $65. They are now duplicated, in everything but the material, from 3/16 and ⅜-in. plate at a cost of approximately $17.50 each.

When dipper sticks for the shovels must be replaced, they are now fabricated in the welding shop, and the same with large dipper fronts. The cost of the latter new may run as high as $1200. The repair cost does not exceed $300. They have also built and replaced tractor pads, using common mill plate, effecting a saving there through the use of the shape-cutting machine. All replacement drive-sprockets and idler-sprockets for the screening plant conveyor are made in the shop.

The 10-tank manifold aforementioned furnishes oxygen to 40 stations out over the job, at 100 lb. pressure. The stations are located within a 600-ft. radius of the shop, where the manifold is located. The oxygen is piped to these stations with ordinary 1-in. pipe, welded, a flash-proof trap being located at each station.

Large Acetylene Generator Serves 40 Stations

The acetylene generator previously referred to supplies the same 40 stations. This generator takes 500 lb. of carbide at a charge and has a capacity of 1,000 cu. ft. of gas per hour. It has a 4-tank manifold for regular service, and another 4-tank manifold connected to the same line as an emergency stand-by.

In addition to the manifold system just described, there is another of smaller capacity located at the gravel plant screen house about a mile away. This consists of a 150-lb. acetylene generator and a 4-tank oxygen manifold, connected with stations convenient to work in that area.

To diverge from the shop matters, one or two activities may be mentioned of the many that are taking place outside. Take for example the cement tank over the east-side mixer plant. This expansion tank is 16 ft. high and 12 ft. in diameter. It contains an inner tank, suspended, that is 6 ft. in diameter and 10 ft. deep. This tank was built out of 48-in. by 120-in. sheets 3/16 and ¼ in. thick, embodying both vertical and horizontal welds.

Round-to-Square Transition Makes Tough Welding Job

The sheets were curved by being passed between two mechanical rollers which were turned from time to time. Add to that the fact that the cone had a round opening with a round-to-square transition, containing a butterfly valve, and you have something to set any welder to thinking.

In connection with the mile-long cement line of 11-in. pipe, this all had to be acetylene welded in the field. The pipe was in 40-ft. lengths. After coming from the cement storage plant, it had to cross the river to reach the east side mixing plant. A station was erected on a level with the conveyor belt crossing, and the welding was done from that station. As each length of pipe was welded the whole pipe was pushed across on rollers.

Leaving the shop, we cross the river and once more pass through the west cofferdam area, and Photograph 4 typifies that unending variety of activitives in which welding and cutting are always figuring at Grand Coulee. Here was a section of interlocking sheet steel piling, nearly 100 ft. long by some 50 or 60 ft. high which enclosed a ramp that had served its purpose and was to come down.

In no time at all, cranes and caterpillars were at work upon it and it was jerked over on its side. Then, from somewhere out of the big "hole," 6 burners with their foreman hove in view and swarmed over the steel deck. With

torches they proceeded to cut it up into small sections, so that the whole thing could be removed from the site.

After all is said and done, welding at Grand Coulee has its thrills as well as its routine. There is always something new to be done that calls for technical knowledge and straight, quick thinking.

Envelope Weld Saves Labor and Material in Small Tanks

By WILLIAM WILSON

In the chemical, food and cosmetic industries there is a large demand for small, rectangular tanks fabricated by welding methods. From the point of view of these industries it is absolutely necessary that the inner surfaces and corners be easy to clean. This requires that all corners and welds be smooth.

Anybody who has tried to fabricate a rectangular tank by cutting out the four corner squares and bending the metal as shown in Fig. 1 realizes that, while the welding may be comparatively easy, it is often necessary to run a heavy fillet on the inside to make the weld smooth. This means that the welder has to work with his head practically inside the tank, and has the discomfort of getting all the heat reflected into his face, which is not conducive to good work. Dressing and chipping the inside corner is not easy, while difficulties encountered in grinding an inside corner weld involves such matters as the size of the grinding wheel and the manipulation of the body of the grinder.

Fig. 2 shows a tank in which all welds have been taken out into the open. They

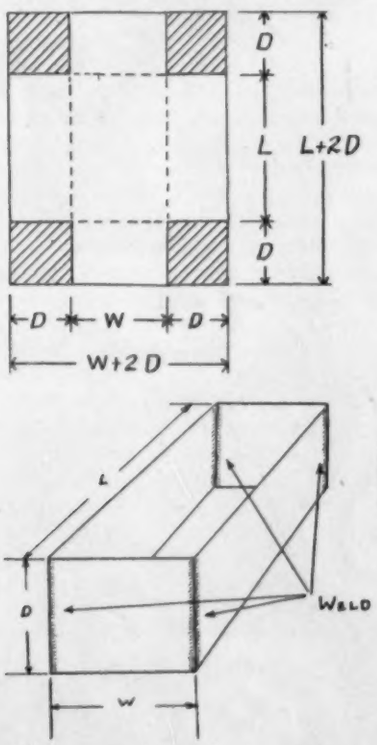


Figure 1. Design with Corner Welds.

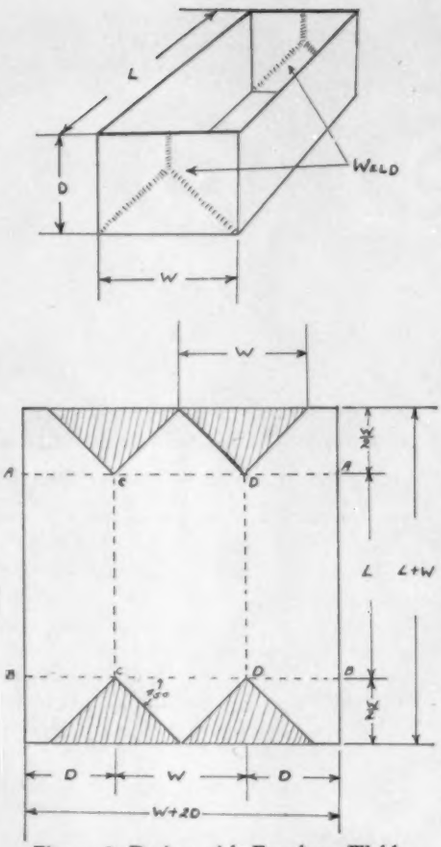


Figure 2. Design with Envelope Welds.

are all in the flat ends of the tank. For most metals of reasonable thickness, all the welds can be made from the outside. Dressing such welds consists of a light chipping, followed by hammering and finishing by grinding and buffing. The outside is finished in the same manner.

The tank is laid out as shown in the plan view of Fig. 2. After cutting along the heavy lines, it is bent to shape by breaking to 90° along the dotted lines *A-A* and *B-B*. Then the sides are bent along the lines *C-C* and *D-D*. This leaves the tank ready for welding, which, with its attendant dressing and buffing, is comparatively easy.

This method also has the advantage of a saving in the amount of scrap, so long as the width is less than twice the depth. By the first method the scrap is $4D^2$, where D is the depth of the tank. In the second method the scrap is only W^2, where W is the width of the tank. This means that there is a saving in scrap so long as W is less than $2D$.

When the width W is greater than $2D$, so long as the scrap is removed by cutting out triangles, the scrap is the same in both cases. Of course, here the advantage is obtained by the ease in welding and finishing.

There is also a saving in welding for tanks when the depth is greater than the width. The welding length in Fig. 1 is $4D$. In Fig. 2, since we have cut the tank at 45°, the length of the weld is $2(D - W/2) + 4 \times 1.414W/2 = 2D - W + 2.828W = 2D + 1.828W$.

This length is equal to $4D$ when $W = 2D/1.828 = 1.094D$, or to all practical purposes when $W = D$.

The above method of laying-out and cutting tank metal has three advantages: First, it gives a weld that is easier made and faster to dress. Second, for tanks with a width less than twice the depth, there is a saving in scrap. Third, for tanks where width is less than the depth, there is a saving in welding.

Many Parts Enter Making of Truck for Field Welding

The ingenuity shown by some in building portable welding sets is illustrated by a truck built by C. H. Foltmer of the Atchison Welding & Machine Shop, 822 Commonwealth Ave., Atchison, Kan., which contains parts from several different kinds of cars and trucks. This truck, for transporting the shop's welding outfit, is a 1924 Hudson, with a Model A Ford worm-drive truck rear-end, a Chevrolet truck frame and rear springs, with a stub of an Essex driveshaft connecting the Ford driveshaft to the Hudson transmission. The Hudson doors were used, but the tin sides of the truck were taken from some road signs. The framework was Model T Ford frames and 1x1-in. angle iron. The total cost, with painted sign, was $185, which includes no charge for spare-time labor. The truck carries a 60-lb. acetylene generator, two oxygen tanks, 200 ft. of hose, an arc welder consisting of a Pontiac engine and 200-ampere generator, and 125 ft. of cable.

Orders $600,000 Worth of Watercraft in Five Months

The Campbell Transportation Co., of Pittsburgh, Pa., who have virtually standardized on all-welded equipment for inland-waterway freight service, have placed orders so far this year for about $600,000 worth of new floating equipment. Charles Campbell, head of the company, is an enthusiastic welding advocate. During the month of June, the Bethlehem Steel Co., from its marine ways at Leetsdale, Pa., launched the last of four all-welded tank barges for the Campbell organization, and the Dravo Contracting Co. delivered the first of three all-welded fuel flats to the same interests.

Leon C. Bibber Joins Carnegie-Illinois Steel

Leon C. Bibber, senior welding engineer, Bureau of Construction and Repair, Navy Department, has been appointed welding engineer of the Carnegie-Illinois Steel Corp., with headquarters at Pittsburgh, Pa.

Car Builder SAVES WEIGHT, INCREASES STRENGTH With WELDED LOW-ALLOY STEEL

IN 1934 two experimental five-section articulated subway-elevated cars were built for the B. M. T. Lines, New York, N. Y. They were designed to speed local service up to almost express schedule by quicker acceleration and deceleration, without making necessary any reinforcement of the existing elevated structure.

One of these multi-section cars, shown in Fig. 1, was constructed by the Edward G. Budd Manufacturing Co., Philadelphia, Pa., in "Shot-Weld" stainless steel construction, and weighed substantially less than comparable cars of conventional design.

As a means of contributing to the weight reduction of the multi-section car, welded steel truck frames, bolsters and spring planks, fabricated by Lukenweld, Inc., division of Lukens Steel Co., Coatesville, Pa., were used on the Budd-built unit placed in service in July, 1934.

Fig. 1. Multi-Section Stainless Steel Car.
(This car, which has welded steel truck frames, bolsters and spring planks fabricated by Lukenweld, Inc., was constructed by the Edward G. Budd Mfg. Co., of Philadelphia.)

Truck Frame Made Up of 78 Separate Pieces

Fig. 2 illustrates one of the welded steel truck frames, fabricated from Cromansil steel. It was made up of 78 separate pieces of varying sizes and shapes, integrated by welding. The range metal was 9/16 in. in thickness, and the webs in general were of 5/16-in. plate. The method of carrying the journal reaction into the frame proper, and the method of producing the journal-box guides from a single formed plate, are clearly shown in the illustration. This frame, one of six produced for the Budd-built train, weighed approximately 1,500 lb. before machining.

Fig. 3 shows one of the welded steel bolsters, also fabricated entirely from Cromansil steel in the weldery of Lukenweld, Inc. This structure weighed 340 lb. before machining. Fig. 4 shows one of the welded steel spring planks of Cromansil steel for the same multi-section car, which weighed 200 lb. as shipped from the weldery.

The Budd-built multi-section car was placed in service in July, 1934. A close-up view, showing the articulation of the units and one of the welded steel trucks, is shown in Fig. 5.

As a result of the experience gained in the operation of the two experimental trains, the B. M. T. Lines recently ordered 25 five-car articulated units. Ten were purchased from the St. Louis Car Co., St. Louis, Mo.

In considering the type of truck frame, bolster and spring plank for these units, a number of designs were studied. One design, in pressed steel and castings integrated by riveting, showed fairly favorable weight, but was estimated to be 4,000 lb. heavier per train than the welded design. The saving in weight made possible through the welded design—comprising two-thirds of the total weight variation permitted in the building of the units—was obviously highly desirable, not only from the standpoint of power saving in train operation, reduced wear and maintenance on wheels, track and other elements, but also because it would eliminate the necessity of making other reductions in the weight of the car structure which might reduce its collision strength.

The St. Louis Car Co. therefore proposed and the B. M. T. Lines accepted Lukenweld, Inc., welded steel construction for the truck frames, bolsters and spring planks. The welded truck frames are composed of pressed plate members of Cromansil steel, generally ¼-in. thick, and electric-furnace castings of Cromansil analysis.

Fig. 2. Welded Steel Truck Frame.
(Fabricated from Cromansil steel, and weighing about 1,500 lb. before machining. Used on multi-section car built for B.M.T. lines.)

Duplicate Units Alter Design From Production Angle

Due to the greater quantity of duplicate units involved compared to the six frames, bolster and spring planks required for the original Budd-built experimental train, an entirely different design viewpoint was necessary from the production angle. Introduction of formed plate sections became economically attractive.

It was also considered advisable to apply the swing-link bearings (which

Fig. 3. Welded Steel Bolster.
(This weighed approximately 340 lb. before machining.)

Fig. 4. Welded Steel Spring Plank.
(This weighed but 200 lb. as shipped from the weldery. Like other pieces described in the article this device is lime-washed to reveal any distortion under testing.)

had been built into the original six frames) at the final assembly of the truck. Small pads, machined to take the bearing blocks welded on at the final assembly, were welded to the top flange of the transom members, thus eliminating the drilling and boring operation, which would have been relatively costly if done on the completed frames.

Consideration of contours at the intersection of formed sections, plus the small details incidental to the support of brake rigging at these points, dictated use of Cromansil steel castings in the corners where the transom intersects the side members.

In the new design of welded truck, an important change was the introduction of single-shoe brakes. The two brake cylinders were located at the extreme ends of the truck, diagonally opposite. The small details, the box section necessary to resist lateral stresses set up by cylinder reactions, and the quantities involved, combined to indicate the desirability of cast-steel pedestals, which were made in Cromansil analysis.

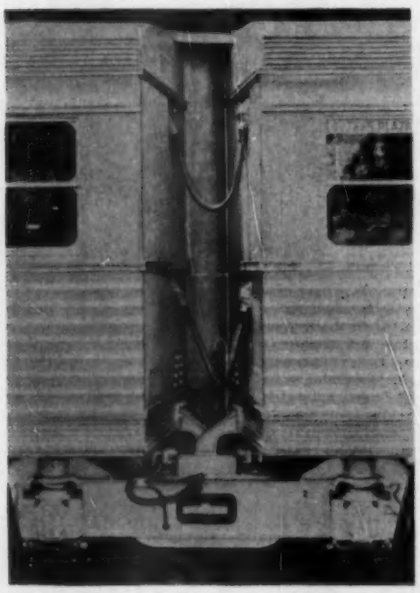


Fig. 5. View of Articulation.
(In this close-up can be seen one of the welded steel trucks which serves two sections of the car.)

Steel Castings Butt-Welded to Formed Sections

These castings cease, and are butt-welded to the ¼-in. formed side-member sections, at points immediately behind the inner journal-box guides. Due to their complicated nature, the thinnest metal section that could be obtained, consonant with sound castings, was ⅜ in.

At a center plate loading of 34,000 lb., the design stress in these trucks is approximately 24,000 lb. per sq. in., which is about 40% of the endurance limit of the base material, as shown by rotating-beam tests. The experimental truck frame was found adequate for this design stress, and as an additional precaution all fillets were carefully ground and considerable effort was expended in eliminating abrupt changes in contour.

Cromansil steel, in a 0.17%-carbon grade, shows a yield strength of about 62,000 lb. per sq. in., an ultimate strength of 95,000 lb. per sq. in., and an elongation in 8 in. of 26%.

The carbon content is purposely limited to 0.17% because the welding heat damages the higher-carbon steels, and while these trucks are thoroughly heat-treated after welding, it is possible that at some future date minor repairs or additions might be necessary on the trucks, and the low carbon content of the steel assures completion of any such repairs with minimum hazard.

While the design stress of 24,000 lb. per sq. in. may seem to be high, it is

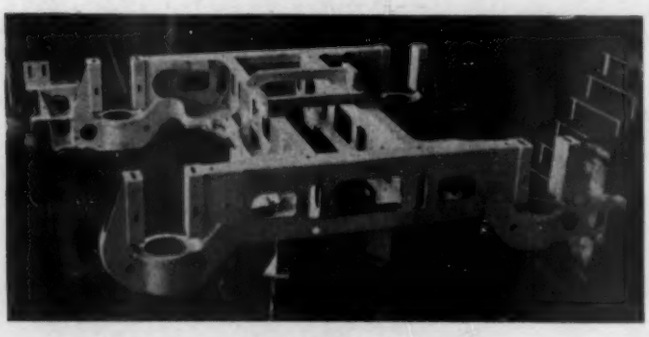


Fig. 6 (Left). Top View of Set-Up for Testing Frame.

Fig. 7. Closeup of Buckled Web.
(The welded steel truck frame was tested to the point of failure. The buckling appears to be a pure column failure.)

the sum of the stresses due to all possible loads that might occur at the same time. Several units of welded railroad equipment have given successful service over a period of years working at this stress. Notable examples are the welded-steel underframes, fabricated by Lukenweld, Inc., in service on the first Burlington Railroad three-car *Zephyr* and other high-speed streamlined trains, in which the calculated maximum stress is 26,000 lb. per sq. in.

In Cromansil steel and at the working stress of 24,000 lb. per sq. in., the total weight of two pilot trucks, four articulated trucks, six bolsters and six spring planks is 10,710 lb. per 127,000-lb. train, which gives an average weight per truck of 1,785 lb., including spring plank and bolster.

Fig. 8. Spring Planks.

(These are of welded steel and weigh but 80 lb. each. Welding effected a notable saving over casting.)

Fig. 9. Bolsters.

(These are of welded steel, and are considerably less bulky and lighter than if they had been cast. They weigh 270 lb. each.)

Absolute minimum weight was essential in the trucks of these trains, due to the fact that they are to be placed in local service in which express schedule time must be maintained, and the accelerations and decelerations on local service are very frequent. Therefore, the inertia of the train must be as low as is consistent with long service life and safety.

Destruction Test Necessary to Determine Frame Strength

In view of the fact that the webs of the trucks were rather completely cut up with holes required for accessibility to the brake shoes and other working parts, it was believed that a destruction test was the only method by which some idea could be obtained of the overall strength of the truck frame itself. This test was conducted in the weldery of Lukenweld, Inc., at Coatesville, Pa.

Fig. 6 shows the top view of the test set-up in which the main load is applied through the hydraulic jack seen at the bottom of the picture, through an X-shaped member to the swing-link hanger pads, and the reaction was taken through four tie rods, the nuts of which seated on the insides of the spring pockets.

The vertical oval holes in the side member are cut adjacent to the intersection of the transom. These holes are required for the passage of conduit and air-pipe connections through the side members. It was believed that this region was beyond analysis, and it was also thought that these holes should be reinforced. For purposes of the destruction test, the reinforcing bands deemed necessary around the holes were not welded.

After the truck frame was thoroughly lime-washed, the load was applied in increments of 5 tons up to 85 tons, and this load was released to determine if any permanent set had occurred. No permanent set was discernible, and the load was then increased to 99 tons, at which point failure occurred by crippling of the thin, unsupported transom web at the point where the transom intersects the side member. Fig. 7 is a close-up photograph taken of the edge of the buckled web. It appears to be a column failure.

Tack-Welds Break in Test But Main Welds Hold Firm

No flaking of the lime-wash occurred at any point, and the tack welds around the reinforcing bands in the side member broke, which showed the need for reinforcement at that point. The only suspicion of flaking of the lime-wash occurred around the 1½-in. hole just below the reinforced openings as shown in Fig. 6. None of the main welds showed any distress whatever.

After the transom web crippled and unloaded itself, a general distortion occurred on that side of the frame.

It was believed that the ratio of the crippling load to the working load was sufficiently high to warrant use of the design, without changes.

Steel frame planks, bolsters and truck frames are shown in Figs. 8, 9 and 10. All these units were fabricated on a quantity production basis.

Fig. 10. Group of Welded Steel Truck Frames.

(The weight of these massive looking structures is but 1,435 lb. each, and their strength is unusually high for such a light weight, as exhaustive tests proved.)

WELDING and CUTTING

Play Important Roles in

STRAIGHTENING of TILTED BRIDGE PIER

WELDING and cutting operations involving novel applications have just been completed in connection with the straightening and strengthening of Pier No. 2 of the Columbia Highway cantilever bridge at Grand Coulee dam in Washington. No construction job of a like nature had ever before been undertaken, it is claimed.

The bridge had been built for the Bureau of Reclamation by J. H. Pomeroy, Inc., of San Francisco, and was completed late in 1936. Just before completion, a slip in the river bank, at the foot of which the pier stands, caused such pressure on the land side as to tilt the top of the pier inward 9 in.

While the shore arm of the cantilever could be connected with the land pier by lengthening some of the expansion slots, so that the bridge could be put in service, it was necessary to apply a remedy to bring the pier, 148 ft. from bed rock to cap, back into alignment and strengthen it against future movement.

Very briefly stated, the plan employed by the Pomeroy company was to drive a circle of sheet steel piling to bed rock, surrounding the pier. As fast as the piling was driven, the earth was excavated and a series of solidly welded rings placed inside the piling to hold it in the form of a true circle against the enormous pressure of the material outside.

The depth of the excavation was approximately 80 ft. and the diameter 110 ft. The caisson formed in effect a steel drum with the rings acting as "inside hoops." The rings were held by shoring timbers braced radially from the pier, and were held equidistant from each other at all points by vertical timbers between the rings.

Huge Concrete Slab Poured to Hold Pier in Place

With the completion of the excavation, the narrow crack in the foundation closed and the pier came back once more into the vertical position by its own weight. Then a concrete slab, shaped somewhat like a great boot, was formed around the base of the pier, after which the remainder of the space inside the caisson was filled with earth.

Looking Into the Caisson.

(Showing the two top rings which were the first to be fabricated and used as guides for the piling.)

From the Bottom of Caisson.

(Most of the rings are visible, including the pair of rings at the offset.)

The art of welding has greatly facilitated this work—in fact, made it possible. Especially was this the case in connection with the rings or ribs. These were individually fabricated by cutting short segments from 36-in. I-beams on cutting tables outside, and then assembling them inside the caisson, forcing them outward against the piling and then welding them together so as to make a solid ring. Each ring was so made of 26 segments, placed with the webs horizontal. On part of the work, powerful hydraulic jacks (two jacks to the segment) were used to force the segment against the piling.

First the ground around the pier was leveled off and a ring laid out, having the correct diameter, and welded. Then another ring, which was to be the topmost ring in the caisson, was set up on blocking above the first and welded, the two being carefully lined up vertically. They formed a guide for the pile-driving with the addition of a further timber guide built at some height above the two rings.

Rings Assembled and Welded Inside of Caisson

The piles were then started clear around the circle and driven to a depth somewhat below where the third ring would come. The interior was then excavated and the two top rings let down into the hole and held against the piling by the shoring timbers. The excavation was then continued down to the point where the next ring would come

Near Wind-Up of the Welding.

(Operator's shield can be seen just past the vertical edge of pier, welding up the flange of a ring segment.)

and it was assembled inside and welded as above explained.

In this manner the work was continued to the bottom—drive, excavate and ring. Quicksand was encountered near the top, and at a depth of about 30 ft. the pressure against the piling had become so great that it was at the point of refusal.

Piles Butt-Welded Together and Reinforced with Scab Plates

Permission was then granted the contractors to make an off-set, 3 ft. in radius, and start a new series of piles and rings on a circle 104 ft. in diameter instead of 100 ft. This enabled them to get to the bottom without further serious difficulty. All the piles were also driven in comparatively short lengths, butt welded together and further strengthened by scab plates.

The amount of steel piling required was 385 tons, in 40-ft. lengths, 16 in. wide, Carnegie M-13 section, 37.3 lb. per ft. The steel I-beams for the rings had a total weight of 550 tons. They were 36-in. I-beams, the largest rolled, weighing from 132 to 230 lb. per ft., depending on the distance down from the top, much heavier rings being placed low down in the excavation. It can be seen, therefore, that a major field-welding job was carried out here.

The plant needed to do the work was located in a building near the mouth of the pit and consisted of five d.c. welding machines, all of 300-ampere capacity.

Approximately five tons of welding electrodes was required, 3/13-in. size being used for vertical and overhead welding and ¼-in. size for flat welding. At times there were 24 welders and burners on the job, the cutting of the segments being a large undertaking in itself, considering that there were no less than 500 of the I-beam segments to be cut.

The segments were butt-welded 100%. For placing and lining up the segments when they were forced out against the piling, a splice plate was run clear across the web on the under side. These plates were provided with bolts to assist in lining up before welding. They also served to hold the metal in welding. Both webs and flanges of the I-beams were beveled.

It was expected that the hydraulic jacks would be of great assistance in forcing the segments of the rings outward until they fell into the 110-ft. circle, before welding. But the quicksand prevented their use on all of the work. Powerful as they were, they could not push the piling out to any extent as it was being driven, although they did succeed in holding it in the form of a circle.

The pressure caused a constant loss of radius, which was another reason for the off-set. By starting over again at the 30-ft. depth the new circle of piling could be started vertical, and below that depth they were soon out of the quicksand. These jacks were 52 in number, each capable of exerting a pressure of 100 tons.

Welded Steel Rangers Replace Wooden Timbers

After the rings were all in the excavation clear down to bed rock, all the timbering still remained. It would not do, of course, to bury this in the concrete slab as it was poured. Therefore it was necessary, beginning at the bottom of the excavation, to construct steel rangers or shores to replace the wooden ones, working up as concrete was poured. These were fabricated from sheet steel piling in the shop above and welded.

F. A. Banks is construction engineer for the Bureau of Reclamation on this as well as the whole Grand Coulee project. M. L. Tibbals is inspector for the Bureau engineers on the pier job, while Charles G. Huber is the general superintendent for J. H. Pomeroy, Inc. Welding has been a large factor in the rapid progress which has been made.

Odd Jobs in the Field Add to Welding Profits

By BENJAMIN NAPHEYS

When a truck equipped for welding work is sent out of town on some special business it is possible to materially increase the profits of the trip by picking up odd jobs along the way, according to Otto F. Boyd, proprietor of Boyd's Welding Shop, Denver, Colo.

Much of this extra work is in making minor repairs on bridges, iron culverts, irrigation pipelines and syphons, and similar jobs which welders in the smaller towns are not able to handle because most of them lack trucks equipped to do work outside of their own shops. Jobs that cannot be brought into them must wait for a welding truck to come along.

When out on the road any bridge, culvert or irrigation pipe in need of repair is noted by the men on the truck, and reported to the proper authorities.

It is not hard to pick up this class of work, according to Mr. Boyd. Ranchmen and others needing welding which is not important enough to justify a truck making a special trip, and which cannot be brought to town, are glad to give it to a welder going through the country on the way to or from a bigger job.

Ranchmen and farmers generally are good prospects for the traveling welder. Repairs to hay hoists, silo elevators and other farm machinery can be made on the premises without the labor and loss of time involved in taking the work to the nearest town.

Much of Mr. Boyd's out-of-town work is in repairing shovel gears and other road-building machinery at the camps where the work is going on. He builds up the gears without taking down the machine.

6,000 Lb. Compressor Welded By Oxyacetylene Method

By DWIGHT ABBOTT

Loss of a 6,000-lb. compressor used in the oil fields was avoided recently when Jesse Jones of the Jones Welding & Equipment Co., of Tulsa, Okla., successfully carried out repair of the inner jacket.

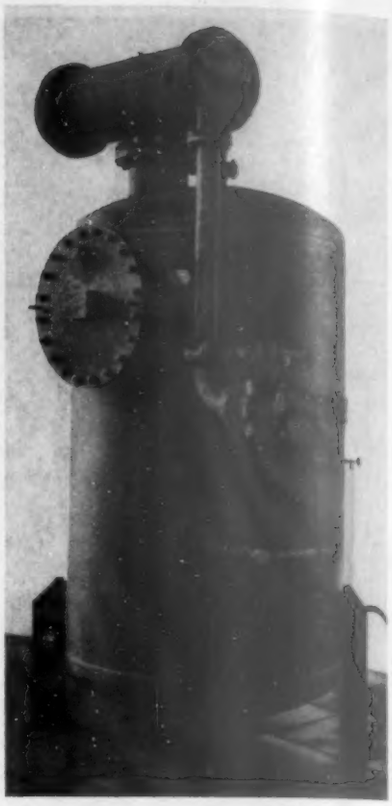
The huge cylinder, property of the Barnsdall Oil Co., of Tulsa, developed a 2-ft. crack inside. The mishap was apparently due to poor circulation and consequent scale caused by the water.

The size of the cylinder—it measured approximately 8 ft. in length and 4 ft. in diameter, and was 3 in. thick—made preheating difficult. Forty-eight hours were required to complete the job.

Sixty pounds of cast-iron rod was used. The process employed was the oxyacetylene method.

ARC WELDING SUPPLANTS RIVETS in CONSTRUCTION of DEAERATING HEATERS

By E. W. P. SMITH
Consulting Engineer, The Lincoln Electric Company



No Rivets in This Heater.

(This vertical deaerating heater, made of Armco ingot iron, is 11 ft. high, 5 ft. in diameter and weighs 4 tons. This vessel is constructed in accordance with the requirements for A. S. M. E. Class 2 unfired pressure vessels.)

MODERN materials and methods of manufacture enable the Elliott Co., Jeannette, Pa., to produce various types of power-plant equipment in an efficient and workmanlike manner.

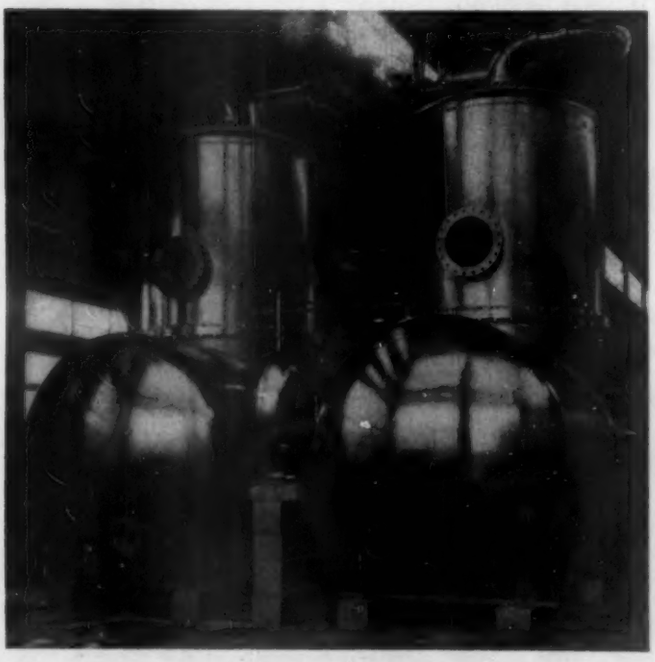
The equipment manufactured in this plant ranges from steam turbines, all types of condensers, deaerators and deaerating heaters on down to such power-plant accessories as strainers, separators, desuperheaters, etc. Because of the tight, permanent construction which arc welding provides, the company employs this process in making many products. This article is devoted chiefly to the item of deaerating feedwater heaters in which considerable arc-welded construction is employed.

Deaeration, as generally understood, implies the removal of oxygen from boiler feedwater. Its broader application, however, covers the removal from the feedwater of corrosive gases present in solution initially, or corrosive gases evolved in the shifting of chemical equilibrium.

Since the first demonstration of the commercial practicability of mechanical equipment for the removal of corrosive gases from feedwater, many types of equipment for this purpose have appeared.

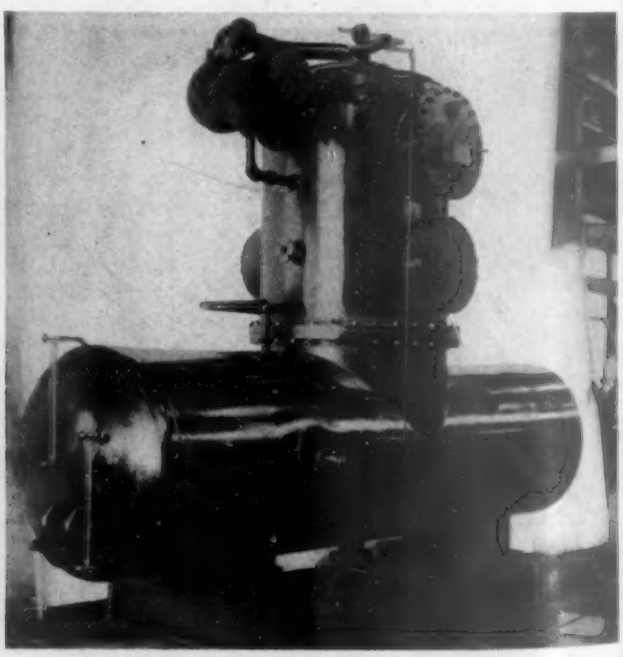
Generally, the variations in type and processes used have been due either to commercial expediency or to changing practice in heat-balance equipment, demanding of the deaerator not only the ultimate corrosive-gas removal, but also an equipment to present the added advantage of maximum possible heating efficiency.

At present, the most widely used deaerator is the direct-contact two-stage type, known as the "deaerating heater."



Arc Welding Built These Heaters.

(Each heater is 7 ft. in diameter, and of approximately 10 ft. overall height. The horizontal storage tanks are 8 ft. in diameter and 16 ft. long. The steel plate is ½ in. thick.)



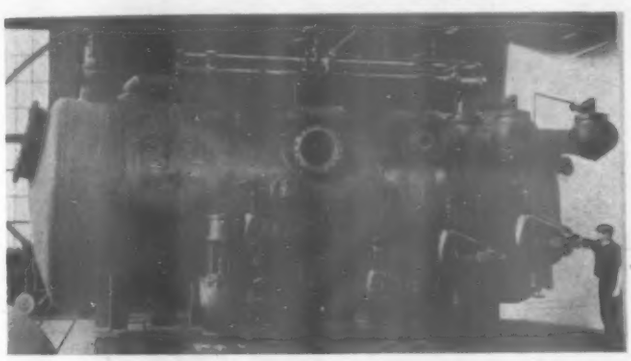
Welded Vertical Deaerating Heater.

(This heater mounted on a horizontal storage tank, is 6 ft. high and 4 ft. in diameter, with a ⅝ in. plate thickness. Both heater and tank were built in accordance with the A. S. M. E. rules for Class 2 unfired pressure vessels.)

The popularity of this type of deaerator is due to its ability to function with a single source of steam and deliver water at the saturated temperature of the steam used for heating and deaerating. This type has the further advantage of low first cost, limited space required for installation, and simplicity of operation.

The properly designed deaerating heater is equipped with a vent condenser to insure proper relationship of flow between steam and water, as well as to recover the condensable portion of the vent mixture and refrigerate the vented gases to a minimum temperature before their discharge. As a heat-recovery device, the added cost of the vent condenser is generally returned within the first year's operation.

Among the design factors affecting the performance of deaerating equipment, steam and water distribution are important. Thus the efficiency of heating and deaerating trays is of paramount importance, as is also the method of insuring uniform delivery of water to the tray structure. The water piping, tray structure, and baffling system must be carefully designed to insure proper coordination of the functions of each at all loads within the maximum rating.



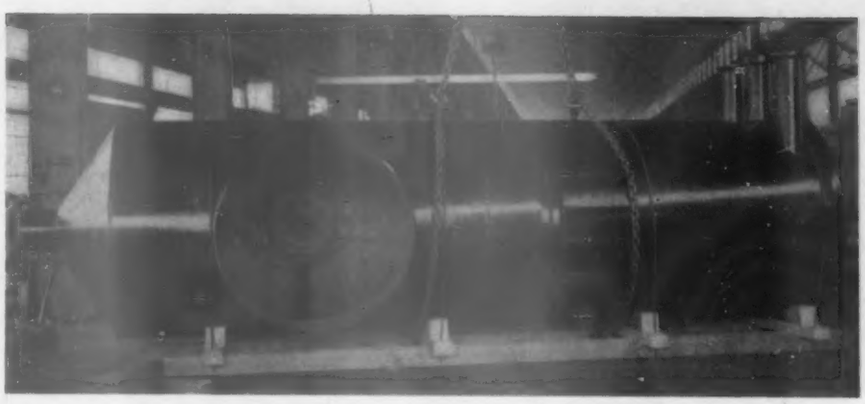
1,280,000 lb. Per Hour Capacity.

(This welded deaerating heater, built for the power plant of a large automobile manufacturer, removes the oxygen from more than 10 tons of water per minute.)

Storage capacity equivalent to two minutes of rated flow is generally provided in the deaerating heater, although occasionally plant conditions require a storage capacity many times this standard capacity. Excess storage capacity can be provided in a separate storage tank from which the feed pump takes its suction, with the deaerating heater mounted directly above. Experience indicates, however, that storage capacity is largely a matter of personal preference, with the exception of the rare cases where rapidly and widely fluctuating load conditions are encountered. With arc-welded construction, large storage capacity is obtained at minimum cost.

Selection of materials for the construction of deaerators and deaerating heaters is important, since the very purpose of the equipment makes it impossible to avoid an extremely corrosive atmosphere continuously in its interior.

Construction has been greatly simplified and improved by adoption of shielded-arc-welded steel construction as opposed to riveted construction. Steel plate having special corrosion-resisting properties is employed. Shielded-arc weld metal, with its high resistance to corrosion, is particularly valuable in this work, and the strength and ductility of the weld metal are superior to mild steel. Even with the greatly improved results, the shielded-arc process of welding provides relatively low fabricating costs due to the high welding speeds obtained.



Welding Cuts Weight and Makes Big Saving.

(Patterns and castings were eliminated and weight reduced when this huge barometric condenser for oil distillation was 100% arc welded from rolled steel plate. The apparatus weighs 22,000 lb., is 23 ft. high, 6 ft. in diameter, and is made of ¾ in. flange steel.)

More Than 1,500 Attend Midwest Welding Meet

More than 1,500 persons thronged the showrooms and lecture hall of the Westinghouse building, 2211 W. Pershing Rd., Chicago, during the First Midwest Welding Conference, held on June 4, 5 and 6, to view the exhibits and demonstrations and hear the many papers that were read.

According to registration officials, more than 90% of those attending were actually in some phase of welding work, and a notable feature of the gathering was the great number of welding operators who came.

The conference obtained an amount of publicity in the Chicago daily press considerably in excess of that usually given to technical gatherings, and the sponsors of the show felt that much had been accomplished in impressing the importance of welding upon the public locally.

Questions and answers were broadcast through the public-address system twice a day. Persons seeking information on any phase of welding wrote out their queries and deposited them in a box. In the morning and afternoon these were gathered and responses given through the microphone for the benefit of everyone.

Gifts of prizes by various exhibitors also served to stimulate the enthusiasm of visitors.

The greatest proportion of visitors at the show were from Chicago and its immediate vicinity, although some came from the Twin Cities, St. Louis, Omaha and Pittsburgh. One visitor registered from Johannesburg, South Africa, and one from Essen, Germany.

Exhibits on Display at Midwest Welding Conference.

A Section Was Sliced Out, and the Building Re-Welded Together!

BUILDING Is CUT APART, Section Removed, WELDED TOGETHER Again . . .

By W. E. ARCHER
Field Correspondent,
The Welding Engineer

THE tremendous growth of Los Angeles in the past two decades, with resultant increase in street traffic, has made it necessary to widen many streets and boulevards, particularly those adjacent to and in the metropolitan area.

Recently the Commercial Exchange Building (shown herewith), a 13-story reinforced concrete Class "A" office building, at West 8th and Olive Streets, extended 5 ft. beyond the newly-established property line. The alterations necessary on this building, in order to make it conform to the street-widening program, gave the owners a very difficult problem to solve, since the street frontage affected by the move provided space for 3 fine offices on each floor, from the second to the thirteenth inclusive; also a very modern and splendidly equipped corner-store space on the ground floor.

However, there seemed no alternative except to cut off the end of the building, and architects were ordered to draw plans for this program. The work was about to be carried out, not only at great cost, but with anticipated loss of future rental revenues, inconveniences to tenants, and also sacrifice of architectural beauty when George R. Kress, Los Angeles specialist in building moving and similar engineering work, was called in for an opinion on the problem.

Mr. Kress suggested a plan of cutting out and removing an 8½-foot section of the structure at a point about 50 feet east of the Olive Street line of the building. This would reduce the building in size only 2 offices on each floor, and would shorten the corridor which lay between these offices. The plan seemed so audacious and revolutionary that it met with great opposition from many prominent builders, contractors, and architects; but after many conferences, the plan was accepted and its execution begun.

5,000 Tons Moved 5 Feet by Hand Power Alone

It is a tribute to modern engineering that with the aid of mechanical devices, a reinforced concrete structure approximately 50x50 ft. and 160 ft. high, weighing approximately 5,000 tons, was pushed and pulled a distance of 5 feet by 21 men exercising only hand power.

These mechanical devices consisted of machine-cut screw jacks specially designed for the purpose. Thirty jacks installed in the basement to push the structure were used at the start, but this number was reduced to 20 as soon as it began to move.

The jacks were 2 ft. 6 in. in length and worked out of punt-log shoes, which made it necessary to reset them as the moving progressed. Each jack had a computed lifting power of 40 tons, and a pushing force of 200 tons. The pulling and bracing devices, 2 of which were installed at every other floor, held the structure in perfect vertical alignment as it moved. Operation of the jacks and the pulling devices was controlled by electric lights, so that the moving force was applied uniformly the full height of the building at all times.

The actual elapsed time required to move the structure the 5 feet, was nine hours. One point of great significance which should be born in mind, is that during the entire operation, with the exception of the 8½-ft. section removed, and the deep excavations in the basement, no portion of the building was disturbed, not even the glass enclosing the storerooms on the first floor; and, although the entire building was filled to capacity with tenants, none of these were in the least inconvenienced.

In fact, many of them were not aware of the fact that the building had been severed into two units, and that in passing through the corridor tunnels, they were walking through space, the top floor being 160 feet above the point of excavation in the basement.

Welding played a very important part in this immense moving program. The section cut out of the building was, as stated, 3½ ft. wider than the setback. This allowed for the cutting off and overlapping and welding of the reinforcing steel in the beams and floor slabs.

Both Sections Joined by Welding Together Overlapping Bars

Under the city ordinance, the overlap had to be 40 times the diameter of the steel. Ordinarily steel ties are used on the overlap, but in this instance the overlapping bars were welded together so that the 2 sections of the building would be firmly tied.

The acetylene cutting torch played an important part also in the cutting of the steel for removing the section of the building. A total of 1,964 welds were made in splicing the reinforcing steel, each weld being approximately 6 in. long. Fourteen ⅜x4x10-in. fish-plates were welded in splicing the supports for the brick and terra cotta at each story.

This unusual welding contract was handled by the Elco Welding Works, of Maywood, Calif., E. L. White being the owner, and he supervised the entire operation. Mr. White states that the actual welding on the entire job was completed in 144 hours. Electric welding was employed exclusively, the oxyacetylene torch being used only in cutting.

This, so far as can be ascertained, is the tallest building that has ever been moved anywhere in the world, and much credit is due the contractors in successfully completing the feat. Aside from a couple of bruised fingers, no accidents occurred during the undertaking.

Get "H. O. T." on Welding

By H. O. T. RIDLON

The Fusion Party

As youse guys and youse gals (yes sir, I'm not forgetting the gals, in spite of the fact that I feel some barber, a real enterprising one, should start a barber shop exclusively for men) know, I'm running for President. Two months ago I promised I'd be forthcoming with more "info" on this subject. And longer ago than that I also said I was going to hold my fire until I'd seen the whites of the enemies' eyes.

And doggone it, those eyes look mighty bloodshot to me. It was two months ago that I gave the slogan that we are going storm into office with. Remember the battle cry: "A welder for President, who will weld business and government together with confidence." Someday we'll give the folks of this great land of ours a torch parade, with torches that are torches, and show 'em our fire.

For a long time I've been trying to make up our mind which of the two present parties should be allowed to muster under our burning torch. Well, after long and careful study (perhaps 30 seconds total at odd times), I've concluded that there are more people that don't belong to either party than do. And that there are many more that think they belong to one of those two parties that are just itching to climb on our little red, white and blue wagon, and ride the glory road with us, so that we can count on them fully 100%.

So now we come to the reasons:

Democrats and demigods, dodling, daring, and doing nothing. Delighting themselves and displeasing us. Distracting business and disgruntled with each other.

Republicans and rubes, riding recklessly, reaching for the moon without rhyme or reason, rollicking to ruin.

Socialist and sillies, sad, sullen, and sassey, sleepily dreaming of someday.

* * *

Free, Fearless and Fastidious

Firmly welded together with confidence in each other, in this Great Land of the Free and Home of the Brave, with sound American traditions and principles, we are all going to hang together, so we won't all hang. And believe you me, boys and gals, that's just what is going to happen to us if we don't. It's to be the Fusion Party, free, fearless and fastidious about honor. No faking or frolicking, except where fun and frolicking belong. But every man to do his job and do it well—rugged, strong, individuals, all ever-building together for greater strength and happiness.

It looks to me as if termites have attacked the Democratic platform to such an extent that it is terminated forever, perhaps.

But I do not give you the conventional platform. How can I tell you what I am going to do when I am President? I am sure, however, that I do not want to be a dictator. I want to be the humble servant of my people, ever at their service to give my all if need be. I give you no platform or promise. Each must prove his worth to get a job, and after he has gotten it, must prove his worth to keep it.

To be very honest, I don't think we'll run the country this year. But we can, if we'll stick together, make our voice heard. We haven't Wall Street behind us, or any organization. We are now however a mighty big organization, disorganized.

Let every welder send me his name, address and his contribution to the party, because it takes the old bucks to put a thing over like this; and when the membership is large enough, both industry and politics will listen to us plenty.

So slip a buck or two in an envelope and address it to me at 200 Park Ave., West, Mansfield, O. Remember, I promise you nothing, and most likely you'll never get anything out of it. This is not a union, so I can't sell you a membership or send you a button. But your name will be listed in my files and some day we may go places.

Every welder in the country should belong to the Fusion Party and not only be willing, but actually contribute, five bucks a year for several years until we build up our great organization into one fast, hard hitting, fearless Party that must be listened to. Line up on the right!

* * *

Mixologists

Down in Terre Haute, Ind., they have a new name for bartenders. Yes sir, at The Terre Haute House there they have gone high hat and call 'em "Mixologists." And speaking of politics, their Master Mixologist's name is Will Hays. But he really didn't look like any pictures I've ever seen in the papers of anyone else by that same handle.

* * *

And here is *news*: Gertrude Menzies, wife of Jack Menzies, who runs the Chicago office of the Stoody Company, won't talk. Can't, she had her tonsils out.

* * *

Hot Sparks

The salesman will tell you that a detour is the roughest distance between two points.

When a man comes home licked at night it is usually because he was licked when he started out in the morning! Life begins at breakfast.

Adversity tries the great man; prosperity the small one.

It seems to me that the smoothest-looking chicken always picks the dumbest looking egg.

It sort of looks like some of the new dresses can be worn either forward or backward, but it would take a very forward girl to wear them backward, and a really backward girl wouldn't wear 'em at all!

* * *

The thought for the month: To our graduates this season, those of the past, and those yet to come—Isn't it strange that the head never starts to swell until the brain stops growing?

ECONOMY and QUALITY In WELDING Through PERSONNEL TRAINING . . .

Delivered Before the Welding Conference of the University of Tennessee, Knoxville, Tenn., April 14-17.

By L. C. MONROE
Advertising Manager
The Welding Engineer

MANY is the time that sales engineers representing welding-equipment or welding-rod manufacturers—yes, even job-welding-shop contractors—have heard the following excuse given as a reason for not welding:

"The idea of welding is something we should consider for the future, but on this particular contract, that we have with the John Doe Company, who incidentally is our best customer, we cannot afford to take any chances."

It is just a plain excuse, in the guise of a diplomatic statement. A good diplomat, it is said, is a man who can state something and really mean something else. Let's change that diplomatic explanation of the reason why they do not wish to weld, into a statement of facts. This explanation, while it tells the truth as to why they do not wish to weld, also supplies the proof that they should not weld.

I am sure that any conscientious sales engineer who has the interest of the welding industry at heart, will agree with me that this concern should not weld this job as long as they hold such a viewpoint.

Objections to Welding Are Generally Evasions

The meaning that the well-informed welding engineer would attach to this excuse would be as follows: "Yes, we know that more and more welding is being done and no doubt similar jobs to this one of ours have been successful. But, you see, we have a business which is a little different than most others. We have $50,000 tied up in machinery for riveting, and what would happen to this investment if we were to start welding? We also have a foundry department of which we are proud. What would our directors say if we should tell them that it has lost a large part of its value and will no doubt be junked?

"It is true we have an arc-welding machine and a gas welding and cutting torch which is under the charge of the master mechanic, and I *guess* that he and the welder are the only ones that know much about it.

"Our engineers, who have all been with us for a good many years, are good men. They tell us that welding is all right as far as it goes, but they will not have any confidence in it until they can tell whether a weld is good without destroying it to find out. You see, they can tell whether a rivet is good or bad. Our metallurgical engineer says he saw a weld that was badly oxidized once, which was enough for him.

"Our superintendent tells us that he wouldn't know where to go and get reliable welders. Yes, it's probably true he wouldn't know a good welder if he saw one, but they will all say they are good.

"The fabricating-shop foreman says it's all right with him if we want to weld, but he is so busy he won't have any time to devote to it. Besides, good welders want more money than we have been paying. We have suffered too heavy losses to increase the operating costs of any department at this time. Yes, our salesmen tell us that the orders are harder to get, but I guess we get our share."

That would be the true statement, but let's boil is down briefly into this statement: "That company doesn't know anything about welding, therefore have no or little confidence in the process, are too satisfied with themselves to adopt anything new and, therefore, not being qualified, should not weld until certain things are done within the organization." Buying welding machines and hiring welders should be saved for the last.

Several years ago, I made the following statement in a talk: "The efficiency of welding in any plant is in direct proportion to the managerial understanding of welding." That is even more true today than it was then.

This paper has been prepared primarily for the industrial plant that has the usual number of departments, such as engineering, drafting, production, purchasing, etc., with also the usual run of men in charge from the president down to foremen and inspectors. All of these I class as "managerial" in the statement I made as to efficiency in any plant.

Economies Can be Realized Only by Training and Study

Through this paper I hope to point the way that will enable plants to take full advantage of the money-making possibilities that welding offers. Also, I shall point out what I believe to be the only way in which these advantages—namely, economy and quality—can be obtained without employing outsiders who have the qualifications for the respective positions. There are at times disadvantages to bringing outsiders, merely because of their knowledge of welding, into the picture. Many times a good knowledge of the products to be manufactured and their applications is exceedingly valuable, ranking equally in importance with a knowledge of welding.

The second objective of this paper is that it will show the necessity for the colleges and universities to bring the subject of welding fabrication into the courses, in proportion to its importance in connection with each course and each student's objective.

The third objective is to show the job welder the necessity of very deep and concentrated study. Please keep in mind that a job-welding-shop proprietor must at times be each one of the men we refer to.

Those of us who have followed the progress of the welding industry closely, have noted several points about welding that have occurred with such frequency and regularity that they have practically become axiomatic in nature. I'm going to touch on two of them briefly.

Welding Costs Are Frequently Higher at First

The first is this: It is seldom, when the first one of anything is welded, that the cost is below or even equal to the cost which applied to that article when made by other methods. But that is not surprising, because it is a 100-to-1 shot that the cost figure against which welding is competing is not the same figure which applied to the first one that was

made by the mechanical-joint method. So, it is only when the skill and brains of man and the sciences of engineering are applied, that real results are obtained in anything—and welding is no exception.

Riveted Structures Should Be Redesigned

The second point is this: Don't leave out the rivets and weld, because the cost is too high. It is, indeed, rare when the conscientious welding engineer or the welding sales engineer (and the percentage of conscientious ones will be about equal to the purity of oxygen) will ever make the following statement to a customer when he has been shown an article designed for riveting: "You have designed this for riveting; now to demonstrate the economy of welding we won't punch these rivet holes, but instead, will weld it." He won't say it, because he knows he is sunk before he starts. That is not the way to apply welding.

The economy of welding is not in the welding rod that is laid down. It wouldn't be so far from the truth to say that the economy of welding is in the welding rod that is *not* laid down.

Comfort Adams, a well-known figure in the industry, and a member of the faculty at Harvard University, says that "the welding engineer is coming to realize that his profession is becoming very, very scientific, and that is rightfully so, because welding today involves more of the sciences than any other profession."

If it is true that welding involves so many and so much, how can any organization go far without a well-trained personnel? That doesn't mean that they all have to be practical welders, but I would suggest that everyone, from the general manager down, at least try to strike an arc, make a gas weld and cut a 2-in. plate. By doing that, they will all find that it isn't quite as easy as it looks.

Study Welding Thoroughly Before Adopting the Process

But let's suppose that this imaginary company that I spoke of at the start, has looked around and comes to the conclusion that *maybe* they should give welding more consideration. They know nothing, or very little, about welding, so how should they proceed? Should they buy some welding equipment, hire some welders and get started? Most certainly not at the moment, because neither the machines nor the welders would have a chance to make good. They should continue to look around until they can build up some confidence in welding, or, to put it another way, until they can look at and discuss welding without having a "chip" on their shoulder.

As they look around, they will come to the conclusion that part of the machinery in their plant for riveting, such as shears, punches, riveting hammers, etc., can be eliminated, but part of it must be retained because some riveting will be continued. Any welding engineer will admit that.

They will find they will not be able to get along without their foundry. While its volume may be affected to some extent, it will be an important cog in the picture. Where the foundry previously turned out a large complicated casting, the finished article will now be composite in nature. By that I mean, that it will be made up of several small castings, some rolled plate, angles, channels, or what not, all welded together. The finished article will be lighter, more efficient and more economical to build.

By now, this imaginary concern of which we are speaking has investigated the field and found welding making strides entirely undreamed of a few years ago by welding's biggest boosters. They recognize that they should have been well along in welding, but here they are, only ready to start. This investigation has removed the "chip" from the shoulders of the executives.

Services of Competent Counsel Are Vital

The desire to weld is present, but the organization is not qualified. The problem is, what to do? There is only one sound answer: Put themselves in the hands of an exponent of welding who is qualified to assist them. This will generally mean bringing in a consulting engineer or a manufacturer of welding equipment, who has an engineering department and is in a position to consult, advise and instruct. This engineer, or the manufacturer who is called in to assist, will make sincere mistakes of judgment, but these will be minor in nature, and low in cost as compared to the mistakes that the company's own organization would make, if they should try to go it alone. The ones called in as consultants will go a long way toward solving the plant's present difficulties, not by themselves, but with the help of the different members and departments of this manufacturing company.

I stated earlier in this paper that in the beginning new welded articles are usually too high in cost. It will be so in this case. The quality will be there and the welded products will function, but reductions in costs—in other words, economy—will have to come later, after this company has gone to school. In other words, the different members and departments will have to prepare for the part that each will play, for to get real economy and true quality they will all have to play a part.

The management in the upper brackets, such as president, vice-president and general manager, will learn that the function of any manufactured article is to do a certain job, and that the welded part need not look like its ancestors. They will soon learn that they will be asked to put the final O. K. on products that will function better, are cheaper to build, will last longer, but in appearance will be, in many cases, radically different.

Welding Will Require Many Changes in Procedure

The purchasing department will learn that they will have to buy to a closer analysis of steel than formerly, which in some cases will mean higher unit prices both for base material as well as welding rods and supplies.

The safety engineer will begin to study eyes and lungs, and give special attention to ventilation. He will find that the best welding lenses are the cheapest in the long run. He will study literature on the safety and health of welders.

The superintendent will find new problems coming to him for decision which will need plenty of study. This man can be a great asset to the welding department, or a serious liability. The answer is up to him.

The engineering department, including the drafting room and the metallurgical laboratory, will have to devote much time to study and analysis. This end is really the key to the whole situation. These departments are generally the source of changes, methods, specifications and materials, and usually have the most to say in purchase of equipment, rods, etc. Some of their problems can be summarized as follows:

Many Problems Will Come Up for Consideration

Riveted articles call for heavier material in order to compensate for weakening effects of rivet holes. This is not necessary with welding, and therefore adjustments must be made in weight specifications.

Many times the use of a higher-tensile-strength material will allow reduction in weight and be more economical than a 55,000-lb. per sq. in. material.

Shall they use an 85,000-lb. per sq. in. welding rod, and do less welding, or a 60,000-lb. rod and more welding?

Shall they use a continuous fillet weld of lighter proportions, or a step weld of heavier bead?

They must know the kinds of weld that can be produced, such as fillet, lap, butt, high or low ductility, welds for wear, etc. They must decide what kind of weld is most suitable, whether it should be of structural grade, Class 1 grade, or tacking grade.

They must decide whether the process should be oxyacetylene, electric arc, or carbon arc, and if electric, whether bare or shielded arc is most suitable and whether automatic, semi-automatic or hand work.

I would emphatically urge that this

department, as well as all departments, consult freely with the welders and welding foremen. The management will find them to be loyal to the best interests of welding and conscientious and proud of their workmanship. They are skilled artisans. They will consult, advise and will likewise be critical, but always with the best interest of welding at heart. They look at welding from the practical side. The engineers will approach the subject from the angle of science and the slide rule. The welders as a rule can't run a slide rule, but they can talk about the relative economies of having to lie on their backs and welding overhead, compared with down-hand welding, and in other ways they can be helpful, if you will give them a chance. As skilled workmen, they will command good wages. Pay good welders good wages. They are worth it.

Metallurgical Testing and Research Are Important

The metallurgist will find that there is a decided trend toward alloys in base material as well as welding rods, such as stainless, manganese, high-carbon and others. He must know how welding temperatures will affect the structure of the base metal, etc. New alloys are being announced frequently. Some of these alloys call for low heats, and with others high heat is not detrimental. The metallurgist will be a busy man in the new picture.

As stated before, the welded articles call for redesign. Therefore, it is up to the designing department and draftsmen to submit detailed drawings, after consultation with others in their own plant, and with anyone else who they will find can help them—and I can point to cases where they have even been willing to talk to salesmen. These drawings will specify where welding is to be done, amount of welding, kind of welding, such as butt, fillet, stitch welding, etc.

Remember, the welders will weld where these blueprints say, they will do it the way indicated, and lay down the amount specified. The welding inspectors—or the foreman, if there are no inspectors—will see that the quality is as specified. But the full responsibility rests where it should—with the specifications.

The average draftsman specifies too much welding because he doesn't know, or he still thinks in terms of riveting.

Welding according to specifications, should result in less trouble from locked-up stresses and strains. I'm not so sure but that in a few years the asylums will be filled with engineers running around wildly with butterfly nets chasing imaginary stresses!

The welding foreman and superintendent will submit a qualification test to all welder applicants. This will weed out many. The welding supervisor will check and see that the welders weld according to specifications. Most all welders are conscientious and will do their best. Remember, if speeds are demanded, which result in poor quality, the welders will become discouraged and become careless.

Sales Department Must Be Welding-Minded

Last, but not least, the sales department must be thoroughly educated in the advantages of welding fabrication, because from now on they will be selling products that will in many cases differ in appearance from the previous design. Many times the article will look frailer, will be lighter, but will be more suitable for the job. The buyer will see these things and he must be convinced that the efficiency is all there, in a larger measure than heretofore.

I believe I have shown you that welding affects practically every department. Now I will show you a few general results obtained by companies who have a managerial knowledge of welding.

A certain nationally known concern had appropriated $42,000 for dies for a year's operation. It was found, through the aid of a gas manufacturer, that a shape-cutting machine could obtain the same results, at a lower unit cost, by the investment of only $4,000 of the $42,000. Also, less scrap was involved.

Higher-Priced Equipment Often Effects Great Savings

Another well-known national concern found that on work involving 2/3 horizontal and 1/3 vertical welding, with 300-ampere, 25-volt welders, the average speed was 6 to 10 ft. with 3/16-in. shielded-arc electrodes. By using 300-amperes *40-volt* machines, the average speed was increased to 30 ft., and it was possible to use a larger electrode. The speed was later increased to 40 ft. per hour, and the quality of welding was not reduced. This concern scrapped all of their 25-volt machines, and bought 40-volt welders. This did not result in less work for welders, because greater markets were opened.

Another concern cut the cost of welding in half by doubling the price paid for welding rod.

Another concern cut their cost of welding and increased the earning capacity of their welders, who were paid on a piece-work basis, by investing in positioning machines.

A certain concern was having too many rejections and the welders were blamed. A well-known welding engineer was called in and corrected the difficulty without going near the welders. The seat of the trouble lay in the way the pieces were prepared for welding. How many times the welders are blamed unjustly!

Another concern found that proper selection of welding leads or cable eliminated their difficulties.

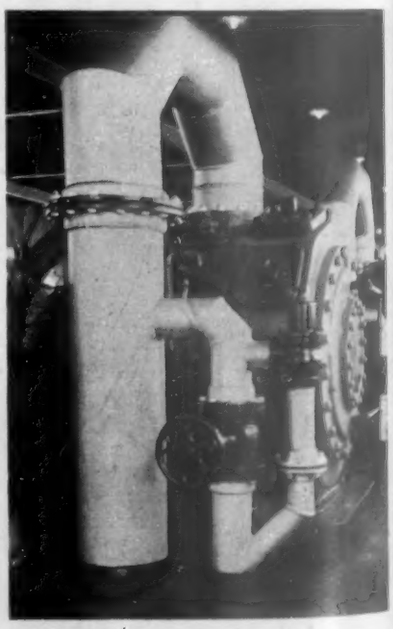
An organization properly trained and instructed is in a position to work out procedure controls, which, in my opinion, is the most successful way to obtain economy and quality in welding. Any concern following this method will never again state: "But on this particular contract we cannot afford to take chances." With a trained organization they will not have to take any chances.

Oil Industry Finds Welding Highly Profitable

Although for a number of years welding has been accepted as an economical means of fabrication in the various divisions of the oil industry, yet it is in the drilling and production of oil and gas that the serviceability, convenience, and economy of the welding processes become particularly apparent. This is revealed by a visit to the newer producing fields, and was particularly exemplified at the Ninth International Petroleum Exposition held in Tulsa, Okla., May 16 to 23.

Here at the exposition were millions of dollars' worth of equipment on display and in operation. One company alone, supplying the oil fields, had over $500,000 worth of equipment set up, including a complete drilling rig in operation.

As an example of how welding is being accepted in the oil-producing industry, one might cite the fact that all the many pumping units on display at this exposition were of steel, wholely or



Welded Gas Intakes and By-Passes to Vacuum Pumps.

(These units as shown have been installed for about nine years, and the intakes and bypasses were welded on the site. The scene is in a casinghead-gasoline plant in an Oklahoma oil field.)

Exchange Heaters in Casinghead-Gasoline Plant.

largely welded, though it was only a few years ago that wooden construction was standard for such units. Also, welding was in evidence on many of the steel fronts, reduction gear units, also drum winches, rotary table drives and many other units.

Many Types of All-Welded Tanks Put on Display

Many types of tanks were on display and most of these were all-welded, including oil and gas separators and other tanks of small dimensions. Such large fabricators as Black, Sivalls & Bryson, Chicago Bridge & Iron Works, and A. O. Smith Corporation, showed many illustrations of all-welded constructions, including field storage tanks and cross-country pipelines.

The welding processes themselves were prominently displayed by a number of exhibitors, including J. D. Adams Co., Air Reduction Sales Co., The Bastian-Blessing Co., Big 3 Welding Equipment Company (demonstrating Lincoln equipment), Harnischfeger Sales Corp., Hart Welding Supply Co. (demonstrating Westinghouse equipment), Keasbey & Mattison Co., The Linde Air Products Co., Una Welding, Inc., Welders Supply Co. (demonstrating General Electric and Meco equipment, with C.I.G. gases), and Wilson Welder & Metals Co.

Concerns connected with the oil industry, including producers, drilling and pipeline contractors and refineries, sent their men in groups to the exposition. It was not an uncommon sight to see a half dozen or more men in their field clothes, from one or two concerns, handling the welding arc or torch in one of the booths, and thereby gaining knowledge regarding the latest equipment and methods of welding. With this sort of cooperation from industry, it is not at all surprising that exhibitors generally expressed themselves in highly gratifying terms when referring to the exposition.

Throughout the Oklahoma and East Texas oil fields, one frequently meets trucks carrying portable welding and cutting equipment. The large contracting companies engaged in drilling have their own crews of welders who travel from rig to rig and from one field to another as their services are required. On the other hand, when breakdowns occur, it often becomes necessary to call on local job welding shops or contractors, who can send one of their portable welding units to the scene, and weld up the job so drilling or pumping can proceed.

In setting up the rigs, old tubing or pipe is used as structural material, and welded together, to form platforms for the drill works, draw works and other equipment. To permit convenient handling in the field, such equipment is built with an underframe usually consisting of two or three parallel I-beams with cross members of pipe, all welded together. This makes a rigid structure which can be pulled into location.

Welding Processes Make for Economy in the Field

In a few paragraphs one cannot mention all the uses to which welding is put in well drilling, but it should be mentioned that it is now usual in many cases, particularly when drilling deep wells, to weld the alloy-steel coupling halves to the drill pipe, as this is said to increase the life of the pipe and couplings.

In the Oklahoma City field rotary drilling is used exclusively since the wells must penetrate to a depth of over 6,000 ft., and as much as $25,000 worth of drill pipe is used to sink each well. The wells in the large East Texas field are only about one-half this depth.

The refinery end of the business is showing progress from both the chemical and engineering standpoint, as well as regards design and fabrication. The new process of polymerization bids fair to show some interesting economies, but it is not yet known definitely just what effect a general adoption of this process will have on existing materials and designs. In the refineries, one sees on every hand welded pipelines, tanks and other equipment, as well as engine-house, boiler-house and other auxiliary equipment fabricated by welding.

Welding Cuts Cost of Original Investment in Oil Well

The welding processes are recognized as a means for making speedy repairs and cutting costs of structures and equipment, all in the name of economy. The need for economy is emphasized by the fact that no part of the huge investment required to dig a well can be realized until the well starts to produce. Therefore, the setting up of the rig and all its appurtenances must be done speedily, though, at the same time, with due consideration of safety, and drilling must be started as soon as possible and maintained steadily until the well is "brought in." Naturally, the erection of temporary platforms and supports falls to the lot of the welder, who also must devise and make chain and gear guards and other equipment to fit the particular set-up. Also it is the welder who is responsible for making speedy repairs so the "outage" time is cut to the very minimum.

The wooden rig, or derrick, has generally given way to steel—riveted in the shop and bolted together in the field, thus allowing dismantling and moving to another location. One manufacturer of rigs emphasizes the advantages of welding when attaching gusset plates to structural members in the shop, and claims that this construction results in greater rigidity and economy in construction than is found in the all-riveted-and-bolted structure.

One manufacturer who has erected many hundreds of oil-field stock tanks—some wooden, some bolted steel and some welded steel—states that a comparison of all factors involved in the erection, moving, and application of these tanks, very definitely favors the welded structure for almost any given set of conditions.

Welded Headers Are Economical in Cost and Quickly Assembled.

Resistance Welding—VI

Theory and Application

(Sixth and last of a series of articles)

By L. H. FROST

Welding Engineer, The Electric Controller & Mfg. Co.

IN THE previous discussion, only mild-steel welding has been considered. In addition to the welding of mild steel, resistance welding is successfully and widely used for fabricating from special sheets and alloys, as well as non-ferrous metals. Special sheets commonly used are galvanized, terne plate and tin plate. Other sheets are available such as chrome-plated sheets. Alloys and non-ferrous metals used for welding vary widely in composition, but some of the most common ones are brass, Everdur, stainless steel, aluminum and high-carbon steel.

In spot welding these materials it is necessary, as in the welding of mild steel, to melt the metals at the desired spot, then forge together and remove the application of heat. Depending upon the nature of the material, it is necessary to apply heat and pressure in proper relationship, some materials requiring relatively low heat and low pressure and others high heat and high pressure. This is necessary to a greater degree than when welding mild steel.

In the welding of coated sheets, it is necessary to melt the coating and then the steel, and to forge the steel together to form a strong weld. This implies that the coating will be removed when the weld is made, and this is generally the case. In some instances the coating may be of such character that it will alloy with the steel, forming a strong weld, and has a melting point so close to that of steel that fusion and alloying take place without disturbing the coating outside the weld area.

Inspection of Table I, giving melting points of various metals, reveals that the chrome-plated sheet will satisfy the above-mentioned requirements since its melting point is close to that of steel, and further it alloys with steel to form a strong weld.

Zinc Coating Melts at Low Temperature

Galvanized iron, however, acts differently. Its zinc coating melts at a much lower temperature than steel, and the zinc-iron alloy (if it alloys) is weak. In this case then, it is necessary to remove the zinc by application of high heat and this results in the coating being burned away at the weld.

Table 1. Melting Points of Various Metals.

Metal	Melting Point, °F.	Metal	Melting Point, °F.
Tin	450	Copper	1981
Lead	621	Manganese	2300
Zinc	787	Nickel	2646
Antimony	1166	Chromium	2768
Magnesium	1204	Steel	2786
Aluminum	1218	Platinum	3191
Silver	1761	Molybdenum	4500
Gold	1945	Tungsten	5400

Table 2. Electrical Resistance with Respect to Copper.
(Copper = 1.00)

Metal	Resistance Factor	Metal	Resistance Factor
Silver	.95	Nickel	4.5
Gold	1.4	Platinum	5.8
Aluminum	1.6	Steel	5.8
Chromium	1.6	Tin	6.7
Magnesium	2.7	Lead	12.8
Manganese	2.9	Antimony	24.2
Tungsten	3.2	Stainless Steel	55.0
Zinc	3.5		

Since the heat available is determined by the resistance of the coating and the steel, this combination further affects the proper application of pressure and current. The electrical resistance of different metals varies widely, as Table 2 shows. For example steel has a resistance 5.8 times that of copper, and stainless steel has a resistance 35 times copper.

Transformer Capacity for Welding Galvanized Sheet

To illustrate how this information is used, assume that two sheets of 20-gauge galvanized steel are to be spot welded. From Fig. 4* it is found that 10 to 30 kva. transformer capacity will be required for clean mild steel, depending upon the welding time. In the case of zinc, which has a melting point of 787° F. (see Table 1), while steel melts at 2786° F., it will be necessary to use a short welding time to avoid burning or melting away a large amount of the coating. Thus, from Fig. 4* it is evident that at least 30 kva. will be required, assuming a welding time as short as 8 cycles, on 60-cycle current. Table 2 shows that the resistance of zinc is 3.5 while steel is 5.8. Hence, to generate the same amount of heat between zinc surfaces would require $\frac{5.8 \times 30}{3.5}$ or 50 kva. However, the amount of heat required to melt the coating is less than for steel because of its low melting point; hence, a capacity of less than 50 kva. and more than 30 kva. is needed. Experience indicates that this analysis is correct, since 40 kva. is found to be required for welding this sheet.

*See "Resistance Welding—II," by L. H. Frost, *The Welding Engineer*, Feb. 1936, p. 38.

In the welding of light-gauge galvanized sheet, sometimes holes are burned through the sheets even when low-heat taps are used. This is due to too low a pressure. The zinc not only melts but becomes gaseous and forms an arc, burning a hole through the light-gauge steel. This can be corrected by insuring that pressure remains on the work after the current has stopped flowing, and also that the pressure is increased to its proper value. Very little success has been attained in welding galvanized steel without destroying the coating on the outside surfaces. It is possible, however, to weld this material without seriously burning the outside surfaces. Under favorable conditions welds having a thin coating of zinc still left on the outside surfaces have been made in production set-ups.

With careful control of current, timing and pressure, as well as careful maintenance of electrode points, welds having little surface indentation may be obtained.

As shown above, high currents are required, in general, for proper galvanized-steel welding. Short welding times are essential for minimum surface disturbance, these ranging from 4 to 8 cycles, based on 60-cycle current. The electrodes found most desirable for such work have spherical or ball points or tips. In production set-ups it has been found that frequent dressings, compared to clean mild steel, are required. For several dressings or cleanings, fine emery cloth may be used to remove any zinc deposited on the tip. A file should not be used. Other dressings should be made in a lathe or other suitable machine which will give true surfaces. Hard copper alloys may be used to advantage. The maintaining of the electrodes should not interfere with production if it is done systematically.

Several solutions are available for coating the surface or weld spots after welding. These solutions are said to deposit zinc salts which resist corrosion and thus retain the original corrosion-resistant properties of the sheet.

Welding Terne Plate and Tin Plate

The welding of terne plate or lead-coated sheets and tin plate is similar to that of galvanized steel; but since the electrical resistance of the coatings is more than steel, the same transformer

capacity as for steel is satisfactory. The same remarks also apply, as made regarding electrode materials and tips for galvanized steel. As in the case of galvanized sheets, it is almost impossible to weld these materials without surface mar and removal of the coating. One method by which the coating of one surface may be relatively well preserved during the welding operation is by using a large, flat electrode on one surface and a ball-end electrode on the other. In some instances it has been possible by this method to make welds in which substantially none of the coating was removed from one side. Due to the spread of the current and the larger thermal conducting area of the large electrode, higher currents will be required than with two ball-end electrodes. This applies to all coated sheets.

Welding Sheets Plated With Chrome or Special Coatings

There have recently become available sheets with special coatings. One of these is chrome-plated sheets. In the welding of this material, which is supplied with a high polish, it is often desirable to leave no indication of a weld on the outer surfaces. By the use of the large flat electrode mentioned above, it is possible to minimize the surface disturbance, though it cannot be entirely eliminated. The disturbance is more noticeable on thin sheets and takes the form of a crater. With pure-copper electrodes, the edges of the crater will gradually rise above the surface as the electrode wears. This crater may be only 1/10,000 in. deep and still be noticeable because of the highly polished surface. The crater is formed by the contraction of the metal on cooling after welding. The flat surface of the electrode maintains the outer surface while the weld is being made and the inner surface is molten, with the result that, upon cooling, the metal that was molten causes the outer surface to become concave due to the contraction.

The welding of other special coatings may be analyzed as outlined above, the principal factors being the consideration of the melting point and the electrical resistance of the coating. It is also necessary to consider the metallurgical angle in that in some cases the coating will alloy with steel and this has some bearing on the resultant weld as regards both strength and surface appearance. There are also coated sheets having some other material than steel for a base, and in these it is also necessary to consider the above factors.

Welding of Alloys Presents Special Problems

The welding of certain alloys has long been somewhat of a problem so far as most users of resistance welding are concerned. Many alloys can be satisfactorily welded, but in general it requires more careful control than the welding of clean, mild steel.

The first consideration in welding an alloy is its electrical resistance. If the alloy has a low electrical resistance, high currents must be used in order to develop the necessary heat between the contacting surfaces. Reference to Fig. 3* reveals that copper will be the most difficult metal to weld since the heat generated will be divided equally between the three surfaces in contact—namely, the surfaces between the sheets, and the two outer surfaces where they contact the electrodes.

The second consideration is that many of the alloys have a very narrow plastic range. This means that too much heat will cause the metal to flow while welding and in some cases will burn holes through the work, and another symptom is the welding of the electrodes to the work. Obviously too little current will not produce any weld, since the material will not reach the plastic range necessary for forging. Depending on the thermal conductivity or capacity of the material to carry away heat, too little current will not produce a weld regardless of the length of time the current is applied. Thus it is evident that careful control of current and time is required when welding alloys.

The more wide-spread use of alloy materials brought into prominence the need of careful timing of current application. This need was met by a number of timing controls which are often used as adjuncts to the existing welding equipment. Thus it is possible to equip most machines with a suitable control which will eliminate the need of careful judgment on the part of the operator. This is particularly important in alloy welding since there is seldom any surface discoloration or evidence of heat while welding. If heat is noticeable, it is usually too late to obtain a good weld, and thus the operator can only guess at the proper time of current application.

It is not possible to apply a timing control as a cure-all. If the welding machine has insufficient current capacity to weld the material under manual control, it will be impossible for the timer to do what the welding machine is incapable of doing. The function of the timing control is to make duplicate welds. This function it performs faithfully, and some controls are so designed that they will produce uniform welds even under varying current conditions.

Welding of Brasses and Other Copper Alloys

The copper alloys were probably the first metals other than steel to be welded in quantity production. Of these it was found that the yellow brasses were easily welded by machines of sufficient capacity. The red brasses are difficult to weld because of their high electrical and thermal conductivity. Considerable research has been carried on by one of the large copper and brass companies looking toward improving the weldability of copper alloys. This work has resulted in several alloys which not only have desirable resistance-welding characteristics but also greater strength than pure copper. The alloying elements used are zinc, manganese, silicon, nickel, beryllium, aluminum and tin. Sufficient information is not yet available to prepare complete curves of transformer capacity required for the various gauges of these alloys, but at this time experience indicates that transformer capacities of about four times the values for steel are required.

Too much care cannot be taken to insure obtaining proper electrode pressure. In order to obtain the most from a transformer of given capacity, it is necessary to use somewhat less pressure than for welding steel. It is important that this pressure be effective throughout the entire welding period because of the narrow plastic range and the short welding period. In other words, the pressure must be uniform as the electrodes sink into the work while welding.

Air-operated machines are well suited to this work, but they should be adjusted to avoid hammering the electrode on the work and causing indentation or "brinelling" prior to welding. Many older types of machines have so much friction in sliding heads and guides as to prevent maintaining proper pressure during welding; with machines of this type, erratic results will be obtained.

In general, short welding periods of 2 to 8 cycles, based on 60-cycle current, are most desirable. The spherical- or ball-end electrodes prove most satisfactory. Hard alloy electrode material may be used, depending on the alloy being welded, but in all cases the electrode alloy with the highest electrical conductivity should be used.

Ball-End Electrode Used For Welding Aluminum

Aluminum and its alloys have become of increasing importance since the advent of the all-metal aircraft which use the strong aluminum alloys to lessen weight. In aircraft work there are many who prefer to rely on riveted structures due to lack of confidence in the resistance-welding process. Aluminum is being spot welded successfully in quantity production, but satisfactory results require the use of machines specially designed for this work. The welding characteristics of aluminum are similar to those of the copper alloys.

*See "Resistance Welding—I," by L. H. Frost, *The Welding Engineer*, Jan., 1936, p. 14.

Transformer capacities approximately five times those for steel, as given in Fig. 4*, are required. Pressures slightly lower than those given in Fig. 5* have been found most suitable.

The spherical- or ball-end electrodes are necessary, but a modified form having a 7° angle has been found very satisfactory and is more easily dressed in a lathe than the ball end. If proper relationships of current, pressure and time are not maintained, unsatisfactory results will be obtained. It is important to properly dress the electrodes at regular intervals or they will "pick up" the aluminum, as it is essentially a soft material.

It is very important to maintain proper welding periods, or the surface of the weld will be burned and the electrode surfaces destroyed. Time values required range from 1 cycle for 22-gauge to 12 cycles for ⅛-in. material, based on 60-cycle current.

The welding machine may be of essentially the same design as for copper alloys, but of slightly higher transformer rating.

Wide Plastic Range Makes Stainless Steel Easy to Weld

The group of alloys known as the stainless steels have probably received more widespread comment than any of the other alloys. Various conflicting ideas have been expressed regarding the spot welding of this material, and there is considerable doubt regarding the corrosion-resistant properties of the material after welding.

Ordinary 18-8 stainless steel itself is one of the easiest metals to weld. The electrical resistance of the material is high and the thermal conductivity low. The plastic range is rather broad, which gives the metal very desirable characteristics from the resistance-welding standpoint. The one difficulty is that when the metal is heated to approximately 1500° F. and allowed to remain at that temperature for a relatively short time (say, ½ second) the chromium precipitates as chromium carbide, and in such state the metal has lost most of its corrosion-resistant properties. This condition can exist when spot welding, but with reasonable care it can be easily avoided. By using water-cooled electrode tips, as illustrated in Fig. 16†, the outer surface of the weld can be maintained at a temperature below the critical point. Further, by the proper control of current and time the thickness of the metal affected by the welding operation may be controlled. Transformer capacities approximately 1/3 of those given in Fig. 4* will be required, with pressures equal to those given in Fig. 5*. Time periods range from 2 cycles for 0.010-in. sheets to 20 cycles for ⅛-in. sheets.

At present, a U. S. Navy specification calls for a satisfactory stainless-steel weld to have a penetration or thickness of from 50% to 80% of the thickness of both sheets. To determine this, sample welds are made. The weld is then cut through the center and filed smooth. The cut surface is then polished with aluminum oxide or some other very fine polishing compound. To make visible the penetration, it should be placed in a solution of 2 parts glycerin, 2 parts HCl and 1 part HNO_3 and the solution heated to 140° F. After a few minutes the sample may be removed, washed and dried, and the weld metal will be visible.

A brown stain will often appear on the surface of the weld. If this stain takes the form of a ring, it is not precipitated chromium carbide, but is only an oxide which may be buffed off without destroying the corrosion-resistant properties of the weld.

As discussed under chromium-plated sheets, it is not possible to weld highly polished stainless steel without distorting the surface. By the use of the flat electrode previously mentioned, it is possible to minimize this distortion, but due to the contraction of the metal on cooling some surface distortion will be noticed.

High-Carbon Steel Requires Annealing After Welding

Another steel alloy which is sometimes considered for spot welding is high-carbon steel. This metal can be resistance welded, but unless the weld is promptly and carefully annealed it will be of such a brittle nature as to be useless. By using very long welding periods and relatively low current values, the effect of annealing may be simulated, but in relatively few instances has quantity production permitted such long welding periods. In general, high-carbon steel has not been successfully fabricated by the spot-welding method.

The purpose of these articles has been to point out some of the factors that influence resistance welding. In general, sufficient information has been given to determine whether a given machine can be used to do a certain job. It is hoped that these articles have convinced production men that the selection and maintenance of the resistance-welding machine deserves the same care and thought as any other production machine. It is only by a knowledge of the factors which influence resistance welding that the art can progress, and it is hoped that these articles will help to that end.

*See "Resistance Welding—II," by L. H. Frost, *The Welding Engineer*, Feb., 1936, p. 38.
†See "Resistance Welding—V," by L. H. Frost, *The Welding Engineer*, May, 1936, p. 47.

*See "Resistance Welding—II," by L. H. Frost, *The Welding Engineer*, Feb., 1936, p. 38.

Sand and Gravel Firm Uses All-Welded Equipment

The Kingston Lake Sand & Gravel Co., Mapleton, Ill., have about completed the assembly of some all-welded sand washers, hoppers, conveyors, screeners and crushers on an old floating drydock. These will be towed to Lacon, Ill., where they will be used in securing and preparing sand and gravel for the Illinois Waterway Project at Whites Crossing, just below Peoria, Ill. Four all-welded steel barges, recently purchased, will also be used in this work, along with two old riveted barges that have had new plates welded on at the water line. Towing of this floating equipment should start in a few weeks.

The cutter blades, cutter head and pump casings of this equipment are of manganese steel and were repaired a short time ago by welding the cutter blades to the head with stainless steel. The blades were then surfaced with a rod developing 50 Rockwell C hardness.

In a recent accident, one of the company's dredge boats received a broken runner shaft. About 8 ft. of it was twisted off and a new piece was welded on. This 8-ft. piece weighed 900 lb. and required about 40 lb. of welding rod and 8 hours welding time. The shaft when completed was 6¼ in. in diameter and 30 ft. long. Welding was done by The Superior Welding Co., 331 Knoxville, Peoria, Ill.

Canadian Boiler Inspectors Adopt A. S. M. E. Codes

The A. S. M. E. Boiler Code (including the Unfired Pressure Vessel Code) and also the Pressure Piping Code were adopted on May 27 by the provincial boiler inspectors of Canada at a meeting held in Toronto. The action taken affects all provinces, except British Columbia.

Coming Events

June 27-Oct. 4. Cleveland, Ohio. Great Lakes Exposition. For information write Ernest Smith, 3910 Carnegie Ave., Cleveland.

June 29-July 3. Atlantic City, N. J., Chalfonte-Haddon Hall. Annual meeting American Society for Testing Materials. For information write Society at 260 S. Broad St., Philadelphia, Pa.

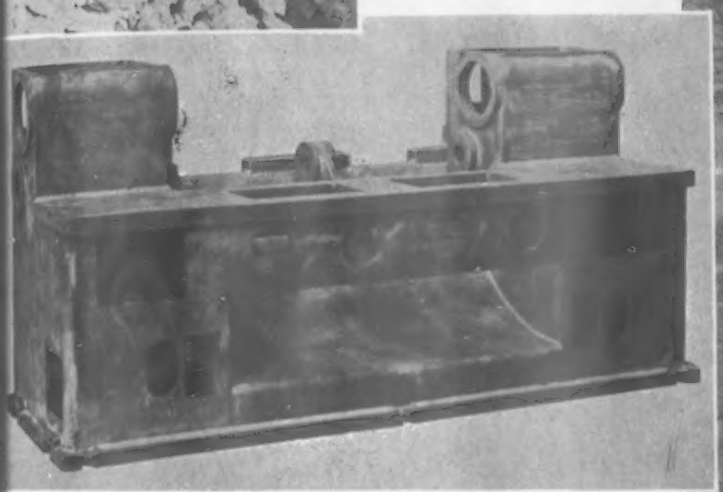
Aug. 11-16. Mt. Pleasant, Mich. Second Annual Michigan Oil and Gas Exposition. For information write R. I. Taylor, manager of exposition, Mt. Pleasant, Mich.

Sept. 22-25. Detroit, Mich. Iron and Steel Exposition. Also annual convention of Association of Iron & Steel Electrical Engineers. For information write John Kelly, Jr., Empire Bldg., Pittsburgh, Pa.

Oct. 19-23. Cleveland, Ohio, Public Auditorium. National Metal Congress. Also Fall Meeting of American Welding Society and meetings of American Society for Metals, Wire Association, and others. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland.

Welding News in Pictures

● (Left) Electric welding at Raisin River crossing of the Michigan Gas Transmission Corporation's 22-in. gas line to Detroit. Welding done by H. C. Price, Inc.



● (Above) Welded construction made a big saving over the cost of casting this special machine tool base, which is 8 ft. long and is made of steel plates. Made by Lakeside Bridge & Steel Co., Milwaukee.

● (Below) This beautiful cup was gas-welded of bronze by Charles Butler of Des Moines, Ia. It stands 7½ in. high and weighs 2 lb. It is a splendid example of welding's artistic possibilities.

● (Above) This stainless steel refrigerator trailer was "shot-welded" together, as are the modern high-speed, light-weight trains. It was built by the Edward G. Budd Manufacturing Co. for hauling perishable foodstuffs.

● (Below) A. F. Davis of Lincoln and B. K. Smith of "Big 3" pose as though they had built this welded pumping unit at the Tulsa oil show.

PIPE Properly WELDED Is Ideal

For HAND RAILINGS . . .

By W. B. EWING
Fabricated Steel Products Co.

PIPE, due to its great structural strength for the weight of metal and its round ornamental surface, is an ideal material for handrails. The first pipe handrailing was made, no doubt, of pipe and regular pressure fittings. Later special ball-pattern, plain-pattern and flush-type railing fittings were introduced, with some corresponding angle fittings for stairs and ramps.

In practically all railings, some portion is on stairways or ramps. If the stair or ramp angle did not happen to hit the stock-angle fittings, the manufacturer had to make up special patterns, and from these cast the parts and machine them—a long-drawn-out (four to six weeks) process which was costly.

Welding Inside of Pipe Presents Problem

With the introduction of gas cutting and welding, the delay of waiting for special fittings was eliminated. But, due to exterior welding, welded railings were unsightly, and it cost a lot of money to grind the welds smooth. If it were only possible to machine *quickly* and *cheaply* the miters and intricate contours of intersecting tubular sections, assemble the machined parts, and then weld them together *inside* the bore of the pipe, or otherwise conceal the welds, the expensive slow hand smoothing-up would be eliminated and the welded rail would be able to compete on a dollar-and-cents basis with the composite fitting and pipe railing.

We had fabricated fitting-and-pipe railings for years, and we tried (so we thought) about every method to eliminate as far as possible the delays due to special castings. We made models of adjustable fittings, had long heart-to-heart talks with foundry connections on quick delivery of special fittings, but we always found that we landed the same place—namely, nowhere.

One Saturday morning one of our customers came in the office very much perturbed. He was a road contractor and was just about to finish a penalty job when he discovered that he had overlooked a ramp railing which, on investigation, required special angle fittings. The inspector would not approve a railing with adjustable fittings or with outside-welded joints. "We are sorry"—but that didn't help him get his job done. The contractor left the office, and we promised to work out "something." Monday morning the inside-welded railing was on paper, and by noon a sample was made and approved by the inspector. We got the order and delivered our first all-steel all-welded jointless-post railing, without a weld on the outside of the pipe.

Pipe Miters Had to Be Cut in Quantity

There wasn't a machine made to cut pipe miters, nobody locally could give us any help on the cutting tools necessary; it had never been done before with the quickness which we demanded. To cut a hole the size of a 1¼-in. pipe clear through a piece of 1½-in. extra-heavy pipe in not over two seconds was a large order. If we could get the hole cut, we knew we could weld the parts together and keep the welds hidden. The automobile industry does the "impossible" in machining operations, and there we found the answer to the "impossible" tool problem.

Accuracy in hole size to the thousandth of an inch, accuracy in angle to the second came next, then full-sized adjustable jigs for welding full-sized railing panels—nothing left to chance. These problems, one after another, were solved.

Curves, Angles, Smoothness All Easily Obtained

Pipe railings on vertical curves, irregularity at no two posts the same, each railing post truly vertical, all made and assembled with the run pipe fitting snug and smooth at each post without particle of weld metal beyond the surfaces of the various pipe components—such a railing is "some railing." Yet with this new construction, it is only slightly more difficult to make than just flat ordinary straight-away railings.

Attachment flanges came in for their share of attention, and we designed both round and rectangular steel flanges which are attached to the posts and rail pipe with hidden welds, or, for that matter, we recommend wherever possible to leave the flanges off as a measure of economy and weld the railing direct to the steel work. Ordinary elbows take up too much room and are available in only a few angles, so we make our elbows out of the pipe itself—perfectly sharp on the inside and perfectly round and true to the pipe diameter on the outside. Caps are formed hemispherically on the ends of the pipe.

Of particular interest to bridge designers is the fact that the dead load of bridges can be materially reduced with the use of this type of welded railing. For instance, our new rails are about 5 tons lighter than the old composite rail were they to be used on a structure the size of the Oakland approaches to the San Francisco Bay bridge.

As to strength, the post in the rail analysis takes all the load. Our railings in every instance have a one-piece post. The post is not broken at the center

Welded Pipe Fence Is Sightly, Durable and Strong

where intermediate rails intersect it, but, rather, is reinforced at this point by the attachment of the various members.

If a welded rail panel is damaged, it is simply cut out with a torch, pounded out straight and set back in place, and the places are welded up where the rail was cut. As there are no fittings to break, a cutting and welding outfit is the only repair kit needed, with the addition of perhaps a file and wrench.

Generally speaking, the old flush type of railing, composed of castings and pipe fastened together with rivets, was a flimsy, unsatisfactory product. The welded flush-type railing is much more rigid; and, because there is no break in the post, the welded rail is much stronger.

Our connector rail simulates in appearance the screwed-fitting type of railing, though it is stronger by actual test.

We find nothing complicated or difficult in the manufacture of these railings, whereas to achieve the same general result would have been extremely difficult and expensive if we were confined to the use of fittings.

Welders Battle Elements to Finish Mountain Pipeline

By C. J. SCHULTE

What difficulties welders of the Thompson Manufacturing Co., Denver, Colo., met and how they overcame them in one of Colorado's greatest projects, G. H. Garrett, vice-president and chief engineer of the company, believes would be a plot for a novel. Miles of piping, part of it 111 in. in diameter, were hand-welded under the most trying conditions when the firm executed a contract for the Moffat project, which will bring water from the Colorado River to the eastern slope of the Rockies, and will increase Denver's water supply by 100,000 acre-feet each year.

"Probably the three greatest difficulties encountered," Mr. Garrett declared, were the extremely high altitude, low temperatures, and resultant low manefficiency. Men had to work in snow all the time and often in a bitter wind. At times the specially built roads had to be cleared before we could go on with our work. We were really up against the elements, and they certainly took their toll of efficiency. Our men were of the best, but they could stand only so much before they were worn out completely."

Closely allied to this problem of low man-efficiency and general discomfort was the human-reaction factor. Wherever possible men were kept busy in order to drive from their minds any thought of hardship. It wasn't a matter of driving men—this was impossible under existing conditions—but rather it was a matter of keeping men busy enough to avoid dissatisfaction.

Time on the job had to be cut to the minimum for this same reason. If all pipe had been welded at the site of assembling, there would have been no end to the job. All piping was fabricated at the factory and shipped by rail to the line in 25-ft. lengths. The work at the factory was all done automatically. The greatest part of it was 52-in. stock.

Once the pipe was on the cars, however, the difficulties had only started. A track to follow the line would have been prohibitive. Manpower was not enough to drag the stock up the mountain sides to the line, so special roads had to be blasted out of rock to make a temporary bed for trucks. The road contractor had to push his work fast enough so his gang was kept ahead of the end of the line. Another contractor kept pace with the road builder in putting up cement supports for the pipe.

Gasoline engines were used to drive the equipment. Besides giving the maximum of power, these offered less of a problem in transportation than other, heavier types of locomotion.

Just how fast the men worked can be demonstrated by the fact that it took three weeks to lay a 52-in. syphon of 1,800 ft. length. In all, the whole job required about three and one-half months.

Referring to the size of the job, Mr. Garrett said: "The project was so tremendous that we seldom knew without consulting our records how many men we had working for us. Many of them couldn't stand the work in such high altitudes, others couldn't stand the cold, so we were always changing workmen.

Welded Under Difficulties

(High altitude, low temperature, bitter winds and rough mountain topography were encountered on this pipeline job.)

"My advice to any company contemplating the taking on of such a job would be to make sure its facilities are big enough to cope with the task. Conditions are so alterable that every factor is changed."

Economic Advantages of Welded Watercraft

In answer to the question, "What are the advantages to the ship owner of a welded vessel over a riveted one?" the following points are brought out by The Ingalls Iron Works Co., of Birmingham, Ala.:

For the same dimensions, a welded vessel is at least 15% lighter. The economies resulting from this weight reduction are as follows:

(1) Due to the saving in hull weight, the welded ship has a correspondingly increased carrying capacity and therefore greater revenue per trip.

(2) Consequently, fewer trips are needed to do the same work, which reduces operating and repairs costs due to wear and tear.

(3) When the ship is loaded, less fuel per ton or cargo is required, as its cargo dead-weight has been increased at no increase in displacement.

(4) When the ship is empty, less fuel is required for the welded ship, as its displacement is less.

Other advantages, irrespective of weight, are reduction of first cost and reduction of the possibility of leakage in the event of collision or other accidents that would damage the plating. Instances in which welded boats have had their plating practically bent double yet experienced no leakage have occurred many times. That a riveted boat, in a similar mishap, would have leaked like the proverbial sieve hardly needs repeating. This is a threefold advantage, as it means elimination of costly delays, elimination of leakage or contamination of cargo, and reduction of repair costs.

The cumulative effect of these economies over the life of the vessel would be tremendous and all out of proportion to the slight saving in first cost.

The question, "How is this reduction in weight achieved?" is answered by listing a few of the items responsible, as follows:

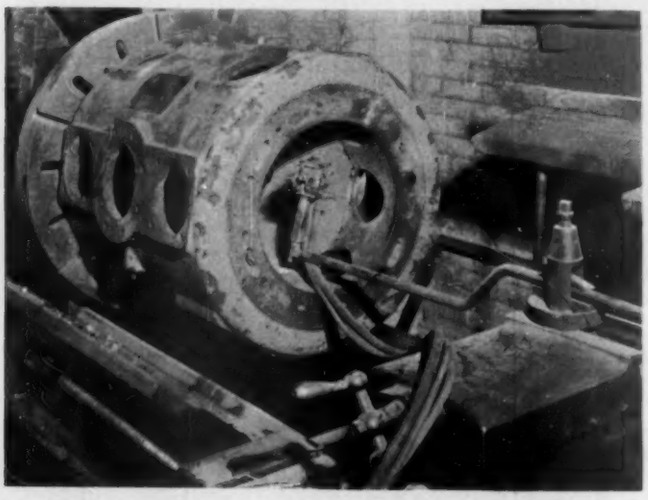
(1) Clips between longitudinal and transverse framing are eliminated.

(2) Laps and seam widths of bulkhead and shell plating are reduced.

(3) Boundary angles for the attachment of bulkheads to plating are eliminated.

(4) Angle stiffeners and frames can be welded with their toes to the plate surface instead of the heels as in riveted work, which makes possible the use of lighter angles to obtain the same stiffness.

Notes on Metal Spraying



Special Tool Holds Metallizing Gun.

Lines Cylinder With Stainless Steel

By using a specially designed tool to hold the "metallizing" gun, the All-Weld Co., of Toronto, Canada, completed the relining of the air-compressor cylinder illustrated. Approximately 3/16 in. of air-hardening stainless steel was applied, totaling slightly more than 30 lb. in weight. The use of metal spraying to apply coatings of harder and more-wear-resistant metals than the base material results in long life and fewer replacements. The gun is mounted in such a manner as to permit its being passed through the cylinder bore. On smaller diameters, internal attachments are used. The inside surface of the cylinder was prepared with a rough thread made with a sharp-pointed tool.

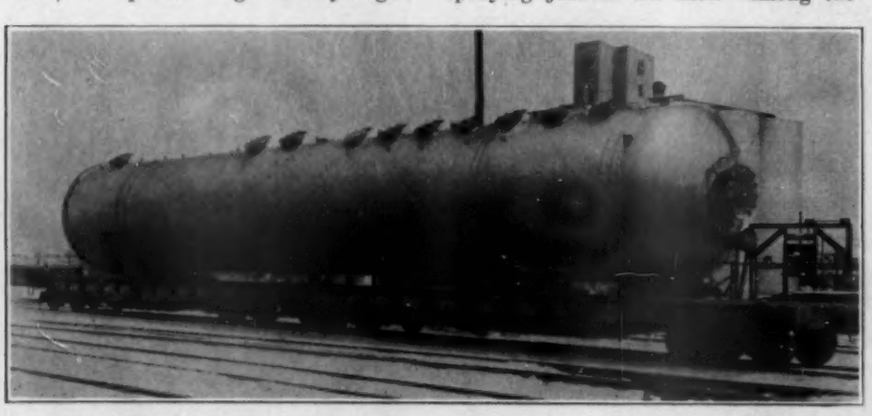
Lining Pressure Vessels

Up to the present, over 100,000 sq. ft. of surface in pressure vessels has been "Metallized" with protective coatings by Metallizing, Inc., of Chicago. One recent job of this kind was the lining throughout of a huge fractionating reaction chamber with pure aluminum, 0.018 in. thick, to protect against hydrogen-sulphide corrosion. The entire interior, including all baffles, angles and stand pipes, was blasted and "Metallized" at the rate of 1,000 sq. ft. per day, with 18 men working in shifts, 24 hours a day. The vessel was built by the A. O. Smith Corp., of Milwaukee, for shipment to the Dutch West Indies. This process of lining is applicable to both new and old vessels, and many successful jobs have been done on ald equipment during regular shut-down periods.

Equipped for Field Operations

By mounting their metal-spraying equipment on a truck, the Libby Welding Co., 2700 East 15th St., Kansas City, Mo., are equipped to handle metal-spraying jobs in the field. Among the many jobs turned out with this equipment is a 54-in. cast-iron strainer, shown in the illustration, which was metal sprayed inside with zinc to prevent contamination in the handling of food products. H. H. Libby, proprietor, also states that the spraying of the inside of engine cylinder heads with aluminum has resulted in a decided increase in engine performance.

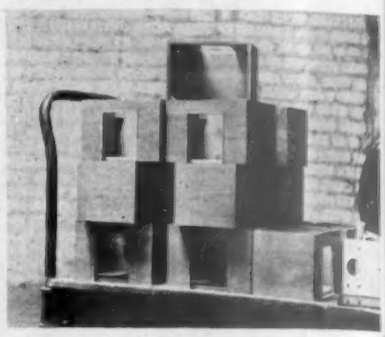
Cast Strainer Lined With Zinc.



Fractionating Reaction Chamber Sprayed on Inside With Pure Aluminum.

Lines Wooden Cabinets With Lead

The spraying of lead onto the interior of wooden radio cabinets effectively eliminates static and acts as a shield, it is claimed. Generally, wood and like substances require no surface preparation such as sandblasting before "metallizing." Thus an application such as this has an extremely low cost and lends itself to production set-ups. Over 500 of these cabinets have been lined so far, says W. C. Reid, of the Metallizing Engineering Co., Inc., of Chicago, and indications are that this will develop into a large-scale production job.



Radio Cabinets Sprayed on Inside.

Meetings

Chicago

Arc manipulation will be the subject of a talk by A. M. Candy, consulting engineer of the Hollup Corp., while R. E. Long, metallurgist with the same company, will discuss the different types of welding electrodes, at the regular monthly meeting at the Welders Information Center, 741 West 70th St., Chicago, to be held on July 7. Two arc-welding machines of a newly developed type will be on display, and all present will be invited to use these machines.

Los Angeles

The May session of the Los Angeles section of the American Welding Society was held in the evening of the 28th, following the usual 6:30 dinner. The meeting was held in the Chamber of Commerce Building, at 1151 South Broadway, in Los Angeles, and was presided over by Chairman J. C. Blake.

The speaker of the evening was H. P.

Artist's Conception of New Westinghouse Building.

Vail, Engineer of the Distribution Department of the Los Angeles Metropolitan Water District, who described many interesting applications of welding on Los Angeles' huge water project, now well advanced. The talk was supplemented by a 30-minute talking picture. A general discussion followed which covered several phases of the welding problems on this project. It was stated that some discrimination is being exercised against welding, the facts being evident that competition is, as usual, keen between the cement and steel interests.

New York

The 16th annual meeting and smoker of the New York Section, American Welding Society, was held on May 26. Installation of the newly elected officers (listed on page 26) took place. High-speed motion pictures of the electric arc, taken at 2000 exposures per second, were shown through the courtesy of the General Electric Co., and a film "Heavy Machine Cutting With the Oxyacetylene Process" was shown by The Linde Air Products Co. Cigars, cigarettes and refreshments were enjoyed.

South

"Modern Arc Welding and Its Applitions" was the topic of an illustrated lecture which K. L. Hansen, inventor of an electric-arc torch and consulting engineer of the Harnischfeger Corp., of Milwaukee, delivered before various engineering bodies during a recent tour through the South. His itinerary included talks before the Engineers Society of Chattanooga on May 25, before the engineering societies and senior engineers of Tulane University at New Orleans on May 29, and before the Engineering Club at Memphis on June 1.

Arc-Welded Building For Westinghouse

Simplicity of design, with arc-welded construction, coupled with many new building features including air conditioning, marks the plans for the new warehousing and office building the Westinghouse Electric & Manufacturing Co. is constructing at its Mansfield, O., works. Because the present plant facilities have become inadequate, this modern building is being erected to increase storeroom space and provide new offices for the increasing business of the Merchandising Division. It is expected that occupancy will take place in October.

The building will be triangular in shape, the sides of the right angle being 320x330 ft. A slight bend in the long side of the building makes additional floor space possible so that there will be approximately 305,000 sq. ft. of floor space in the new building. It will be seven stories, or 102 ft. in height, although there will actually only be five stories, since the first two floors have 24-ft. ceilings for warehousing purposes. Each floor will have approximately 60,000 sq. ft. in floor space.

The structure will involve the fabrication and erection of 2,800 tons of arc-welded steel, and will employ the use of a combination facing of corrugated asbestos sheeting and glass.

Northern New York State Welding Club Organized

At a recent meeting in Clayton, N. Y., a welders' club was organized. After a talk by Al. Losch, explaining the purpose of the club, W. Palmer described the various types of electrodes used in welding and their applications to various metals. The next meeting of the club will be held in Watertown, on June 25. Those interested in this meeting should get in touch with John Riddell, care of Frank Snow Plow Co., of Clayton, for details.

Non-technical talks are to be given at all meetings, and practical solutions sought for all welding problems raised. Everyone interested in either gas or arc welding is invited to attend. Each meeting is to be preceded by a dinner. There are no membership dues, but a collection is made at the door to cover meal charges. The club membership is rapidly approaching the 100 mark.

Welded Joints Advantageous For Steam Radiators

The use of a welded joint in connecting steam radiators to the main steam line reduces labor and material costs 50% on the average job. This reduction in costs has resulted in such an increased use of the welded joint in steamfitting that the steamfitters' union of Denver, Colo., has established a school of welding for its members.

Welding radiator connections to the main steam line does away with reducing tees, and with the usual cutting, threading and tapping of the main for each radiator. A hole of proper diameter is drilled in the main line, and a connection for each radiator is welded on.

Before welding the joint, the pipe between the main line and radiator is curved or bent to fit, thus eliminating cutting or threading the connecting pipe for bends or other fittings.

This method does away with repeated handling of the 4-in. mains 18 to 20 ft. long. Mains are cut according to the length of the room, and not to suit the position of each radiator separately. No radiators are connected until the main is in place. Then it is drilled for each radiator, and the connections are welded to the main line.

Motion Picture Relates to "Metallizing"

A 2-reel motion picture on metal spraying has been made by the Metallizing Co. of America, Inc., 1218 Long Beach Ave., Los Angeles, Calif., for loaning to societies, clubs and other interested groups. The pictures show a wide variety of applications and work in production.

News of Welded Pipelines

Contracts were let May 5 by the Valley Pipe Line Company, to Lang Transportation Corporation, Los Angeles, for 70 miles of 10-in. all-welded oil line to extend from the Kettleman Hills oil field to Estero Bay. The project will cost somewhere in the neighborhood of $1,500,000, and is scheduled for completion by August 1.

Work employing an extensive welding program is under way by the Gulf Oil Corporation, of Ft. Worth, Tex., in the construction of a new 25,000,000-cu. ft. (daily capacity) compressor-type casinghead gasoline plant in the O'Brien oil field, in Ward County, Texas. Several miles of welded gathering pipe lines to supply the plant will also be laid this summer.

The San Diego Consolidated Gas & Electric Company has started work on a 15-mile gas main, to extend from Carlsbad to Escondido, California. The line will be welded entirely by the "Lindeweld" oxyacetylene process. The size of the line has not been determined.

What's New in Equipment and Supplies

New Rail Bonds Have High Conductivity

Five new types of arc-weld rail bonds have been introduced by the Mosebach Electric & Supply Co., of Pittsburgh, Pa., for the coal and metal mining industry. These bonds are all made by the electric flash-weld process, affording high electrical conductivity and minimum power losses. One of the new developments is a combination joint and cross bond, which is said to eliminate 50% of cross bond welding. These new bonds were exhibited publicly for the first time at the American Mining Congress and Exposition, in May, at Cincinnati, Ohio.

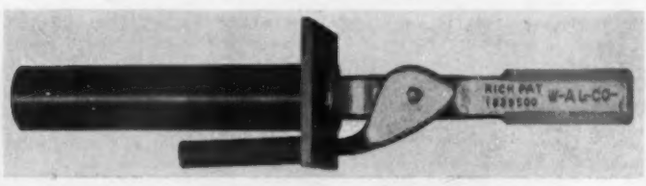
Harnischfeger Introduces "Smootharc" Electrodes

An entirely new line of coated rods for d.c. welding, called "Smootharc", is now being made and sold through the Harnischfeger Corp., Milwaukee, Wis. These include five different types with both high and low rates of fluidity for various types of work in welding in flat, vertical or overhead positions and with ferrous and non-ferrous metals. The "Smootharc" electrodes are designed primarily to speed up welding operations with a smoother, more easily handled arc and to reduce spatter losses.

New Electrode Holder Has Many Features

The Walco electrode holder has been placed on the market by the Welding Alloys Mfg. Co., 5 Wadsworth St., Cambridge, Mass. An outstanding feature of this holder is that the electrode is locked securely into place by action of a cam. When the holder is opened the jaws are sufficiently separated to permit filing away any particles of steel that may adhere. The point of contact between the trigger and the jaws is case-hardened. The holder is said to possess unusually wide jaws for contact surfaces.

Another advantage claimed for the Walco holder is the unusually light weight made possible by the extreme simplicity of construction. It is said to permit of welding in tight quarters and small spaces, because of the short distance from the cam lever where it is locked, to the end of the fiber.



"Walco" Electrode Holder.

New Development in Metering of Oxygen

After two years of research, with the cooperation of the laboratories of the largest producers of oxygen, the American Meter Co., Philadelphia, Pa., has just announced the development of a meter especially adapted to the successful measurement of oxygen.

This meter is their modern "Ironcase" in design, but the materials used in its construction are selected especially for this exacting service. As a result, these meters will successfully measure all the oxygen passing through the line, from the minimum rate of flow to the maximum capacity of the meters.

They are available for low-pressure service as well as for high pressures. Where used for measuring high-pressure oxygen, they should be equipped with a volume and pressure gage, a base pressure index or a base volume index.

Oxygen Meter (Case Removed).

Hammer for Flattening Lap-Welded Seams

A method for flattening the lap-welded seams of ice-cream and milk can bodies involves the use of high-speed riveting hammers specially equipped, as shown by the accompanying illustration.

The size of hammer employed depends entirely on the gauge of the metal and the width of the lap weld. Welds of this character can be flattened at the rate of 1 in. per second. Heavier gauges of metal will consume slightly more hammering time.

Flattening a Lap Seam.

The rapid elastic blows of the hammer cause the welded section to flow evenly, insuring a thickness, after hammering, which is equal to the cylindrical body. Special equipment can be designed to handle more intricate shapes.

The High Speed Hammer Co., 313 Norton St., Rochester, N. Y., who developed equipment for this process, invites anyone interested to submit samples of welded parts so that they can be hammered and returned for inspection.

Cold-Rolled Steel With Good Drawing Properties

Full commercial production of "Armco Stabilized Steel" in cold rolled sheets and strip has been announced by The American Rolling Mill Co., of Middletown, Ohio.

Stabilized steel is offered by the company as a uniform, deep-drawing and non-aging cold-rolled steel with all stretcher strain permanently eliminated in the tempered condition. It retains indefinitely all the properties of temper-rolled steel, making pre-fabrication treatments unnecessary, regardless of the length of time the metal has been in stock.

Unlike ordinary mild steels for deep-drawing purposes, the new metal has no sharp yield point in the temper-rolled condition. It is superior in resistance to cracking in some very severe drawing operations, and will retain its initial excellent drawing properties indefinitely, the company claims.

York Develops Line of Steel Welding Flanges

A complete line of steel welding flanges for refrigeration piping has been developed by the York Ice Machinery Corp., York, Pa.

Made entirely of forged steel, these

Mr. Charles Gallo. He praises Tobin

J. L. WHITE & CO., Inc.
Electric Arc and Oxy-Acetylene Welding Cutting, Welding Supplies Equipment, Oxygen and Acetylene Gases, Carbon Burning
44 North Elm Street — Waterbury, Conn.

August 6, 1935.

American Brass Co.,
Waterbury, Conn.

Gentlemen:

We have used Tobin Bronze since the days when bronze welding was practically unknown...and we still use it. Our men prefer Tobin Bronze because it is so uniform. When a man welds with Tobin Bronze, he doesn't have to keep changing his methods to make up for variations in the filler rods. In all our experience, we have never known Tobin Bronze to vary in the slightest degree...and when we send a Tobin Bronze weld out of our shop, we know it will give satisfaction.

Yours truly,
CHARLES GALLO
J. L. White Company, Inc.

"Our men prefer TOBIN BRONZE because it is *so uniform*"

PRAISE FOR TOBIN BRONZE from Charlie Gallo is praise indeed. For he has been in the welding business 16 years. His long experience has taught him what to look for —and what to avoid—in welding rods.

Mr. Gallo believes in using good stock . . . thinks it pays him as well as his customers. Read his reasons for using Tobin Bronze . . . the original low melting point bronze rod. Uniform always!

Time-tried Tobin Bronze carries the name stamped every 12 inches in each rod. Look for this mark . . . don't gamble on an unproved rod. Make certain you are getting the genuine product . . . *genuine* Tobin Bronze. 38328

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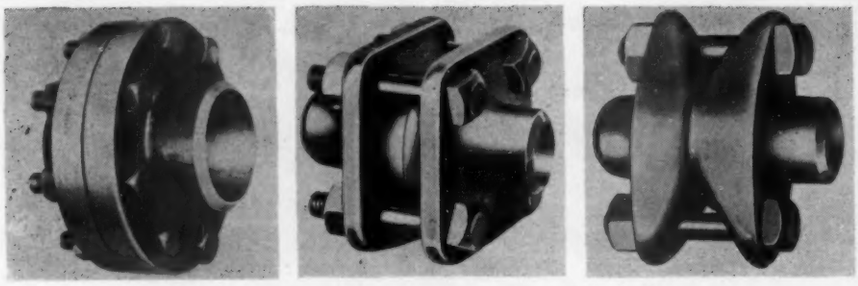
THE AMERICAN BRASS COMPANY

ANACONDA

General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities

In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

ANACONDA WELDING RODS



Welding Flanges of Round, Square and Oval Type.

new flanges are capable of withstanding the highest pressure found in refrigeration service. They are of the tongue-and-groove type, and have practically the same cross-section as York standard screwed flanges.

The extra-long welding neck which insures (1) plenty of room for the welding operator, (2) free-flowing metal, insuring a perfect weld, (3) diffusion of heat, preventing warping of the flange, and (4) liberal clearance for tightening the tie-bolts.

The flanges are made in the oval, square, and round types, in a range of pipe sizes from ¾ to 10 in.

The company has also designed pipe-welding plugs for use as a fixture to hold flanges in line with the pipe during the welding operation. These are of solid copper alloy, which readily diffuses the heat of the weld, and does not adhere to the molten steel.

Automatic Welding With Protected-Arc Wire

The development of the "UnaMatic" shielded-arc welding process has been announced by Una Welding, Inc., Dept. A, Cleveland, Ohio. This method is said to give complete protection to the weld metal by means of reducing gases and a suitable slag covering, and the necessary coating is supplied by a combination of coating on the rod, and tape, resulting in weld metal of protected-arc quality.

Full-size 150-lb. coils of wire may be used. The wire is fed through an automatic head, and current contact is made with a brush of ample contact area. Directly above the arc, tape is fed around the wire by a simple mechanism. The arc length as well as the feeding of the wire and tape are automatically controlled. The protective slag is said to be easily removed.

New Electrode for Light-Gauge Work

"Thinweld," a specially coated electrode for arc welding light-gauge sheet metal is being offered in 1/16, 3/32 and 1/8 in. sizes by The Hobart Brothers Co., Box U-66, Troy, Ohio. Used with low-amperage machines, it finds a use for auto-body and fender work, and fabrication of heating and air-conditioning cabinets, ducts, etc. It has been successfully used on metal as light as 24 and even 26-gauge, it is claimed.

Arc Welding Design Chart for Drafting Rooms

An engineering drafting room chart, 24 in. wide by 35½ in. high, which presents in concise ready-reference form data for arc-welded designs, is announced by The Lincoln Electric Co. The new chart will be found particularly helpful in drafting rooms of companies changing over their products from conventional methods to arc-welded construction. It has a metal strip across the top and bottom and a clip for attachment to the wall.

This chart gives weld symbols for working drawings; illustrations and particulars regarding 16 types of joints for arc welding; illustrated suggestions for arc-welded design; sketches explaining the nomenclature of welds and weld dimensions; a comparison of welded and riveted drawings; and tables giving properties of base metals, weld metals, electrode metals for hard-facing, length of fillet weld to replace rivets, and safe allowable loads for fillet welds in shear.

A feature of the chart, of special interest to companies having large drafting departments, is the fact that it is printed in such a way as to be suitable for blueprinting.

Engineers or men in charge of drafting rooms may secure a copy by writing The Lincoln Electric Company, Welding Engineering Department, Cleveland, O.

High-Strength Protected-Arc Electrodes

Two new electrodes, known as Una 3175 and 3195 Rods, for welding in all positions, have been announced by Una Welding, Inc., Dept. A, Cleveland, Ohio. These electrodes are recommended for the welding of the low-alloy, high-strength steels. They are of the protected-arc type, and give a dense weld metal that is high in yield and strength and highly resistant to corrosion. The weld is fully covered with easily removable slag. The beads are said to be very smooth in appearance.

When used with direct current, reversed polarity should be used (electrode positive, work negative). These electrodes are also recommended for a.c. operation where sufficient capacity is available. The physical properties of the weld metal are as follows:

All-Weld-Metal Tensile Bars (as Welded)	Una 3175 Rods	Una 3195 Rods
Ultimate strength, lb. per sq. in.	75,000-80,000	90,000-100,000
Yield point, lb. per sq. in.	64,000-72,000	80,000-88,000
Elongation, per cent in 2 in.	25%-30%	16½%-20%
Specific gravity	7.80-7.85	7.80-7.85

Trade Literature

A buyers' guide to warehouse stocks of nickel alloy steels has been issued by The International Nickel Co., Inc., 67 Wall St., New York, N. Y., which lists warehouses in the United States and Canada carrying stocks of nickel steels, including stainless steels. A cross-reference index aids in locating those warehouses carrying any specific kind of these steels. S.A.E. steel specifications are given, and also trade names of alloys with chemical compositions.

"How to Use 'Handy' Silver Solders, Sil-Fos and Easy-Flo Brazing Alloys" is the title of bulletin No. 1, recently published by Handy & Harman, 82 Fulton St., New York, N. Y. The results of laboratory and actual production experience are given. Recommended procedure in the making of lap, butt and shear joints is illustrated, together with views of joints that are to be avoided. Hints are given on the saving of time and cost.

A table of data, relating to x-ray work, on each of the 92 chemical elements, arranged in order of their atomic numbers, is given in a folder issued by the St. John X-Ray Service, Inc., 30-20 Thomson Ave., Long Island City, N. Y. Information includes atomic weight, melting and boiling points, valence, density, structure of crystal system, unit cell size, and wave length.

The Bastian-Blessing Co. of Chicago, have just published catalog No. R-100. Gas pressures and consumption charts, an illustrated description of regulator construction and operation, and how to make regulator repairs are some of the technical features. The catalog consists of three sections; namely, outfits, torches and regulators.

Bonney Weldolets and Thredolets, which are pipe fittings especially adapted to making tee, cross, side-outlet, side-outlet and cross, and double-cross branch pipe connections, are described in Bulletin WT21, issued by the Bonney Forge & Tool Works, Allentown, Pa. These fittings may be installed either by oxyacetylene or electric-arc welding.

Bulletin No. 148 describing welding rods, welders, and accessories is being distributed by Una Welding, Inc., of Cleveland, O. The bulletin lists various types of coated and protected arc electrodes, also rods for carbon-arc welding, manganese steel and stainless steel, as well as hard-facing rods.

A new edition of its bulletin, "Portable Cable," has been issued by the General Electric Co., describing various types of electric cables, including tellurium-compounded all-rubber type arc-welding cable for low-voltage applications demanding flexibility.

Bulletin No. 50, describing the wear-, corrosion-, and heat-resistant Colmonoy alloys and overlay metals, has been issued by the Colmonoy Co. of Los Nietos, Calif. Included in the booklet are also descriptions of Colmonoy welding rods and electrodes.

Commercial News

Gas Cutting Demonstrated at South Chicago Centennial

Cutting with propane gas, using Victor equipment, was demonstrated to large audiences by the Chicago Welding Sales Co. during an exposition held in Bessemer Park, at 9000 South Chicago Ave., the week of June 8, in celebration of the 100th anniversary of the incorporation of the town of South Chicago. The cutting equipment was set up and operated in the booth of the Shell Petroleum Corp.

Welders' Association Wants Manufacturers' Literature

A request for literature from manufacturers of welding and cutting equipment and supplies has been made by George A. Combridge, librarian of the Association of Certified Welders. This literature is for the benefit of the membership, and will be on file in the Association's library at 520 Van Ness Ave., San Francisco, Calif.

Ferdinand W. Roebling Is Taken by Death

Ferdinand W. Roebling, Jr., president of John A. Roebling's Sons Co., of Trenton, N. J., died on May 29 of complications following a major operation.

Born in Trenton in 1878, Mr. Roebling was a graduate of Lehigh University, and entered the employ of the family firm in 1901 as an engineer, rising through successive offices to the presidency. He was active in civic circles of his community, and was widely known as a donor to charitable, religious and welfare organizations.

WELDED WITH PAGE

—at a cost that was approximately one-third less than riveted construction!

● This tells the interesting story of the boat pictured above—the first of a fleet built by the Erie Concrete and Steel Supply Co., Erie, Pa.

Page welded construction proved so satisfactory—the performance of the boat itself was excellent—that inquiries and orders for additional boats followed.

The specifications of this boat called for welding, both inside and out. Page Welding Electrodes were used throughout the job. This is but one example of the excellent results obtained with these better welding electrodes.

If your welding problems call for electrodes of general high quality—high tensile strength, a high percentage of ductility, resistance to impact, fatigue and corrosion—specify the Page rod that fits your problem.

The local Page distributor who serves you carries an ample warehouse stock and can supply you promptly.

PAGE STEEL & WIRE DIVISION OF THE AMERICAN CHAIN COMPANY, INC., Monessen, Pennsylvania

District Offices: New York, Pittsburgh, Atlanta, Chicago, San Francisco

In Business for Your Safety

PAGE *Welding* WIRE

The Metallizing Engineering Co., Inc., of New York and Chicago, have opened branch offices in Baltimore, Md., and St. Louis, Mo., and appointed sales representatives in Cleveland, Ohio, and in northern Alabama. William McMakin, formerly of the New York office, has been appointed sales manager of the Baltimore office, located at 5444 Frederick Ave. The St. Louis office, located at 3640 Shaw Blvd., is in charge of W. B. Meyer, formerly of the Chicago office. L. R. Berkeley, formerly with Una Welding, Inc., has been appointed sales representative in Cleveland and vicinity, and E. R. Hauser, of the Electroplate Co., Montgomery, Ala., has been appointed sales representative in the state of Alabama north of Montgomery.

Julius Kahn has resigned as president of the Truscon Steel Corp. to become vice-president in charge of product development of the Republic Steel Corp., Cleveland, Ohio. Other changes announced by Republic include the promotion of Forrest H. Ramage to the position of sales promotion manager, and the naming of Stanley A. Knisley as director of advertising, with Chester W. Ruth made assistant director of advertising.

Harry Christensen, for several years an iron and steel salesman for the A. M. Castle Co., 1300 North Branch St., Chicago, has been promoted to the head of the special products division of the Castle organization. He will have charge of stainless steels, hot rolled and cold finished alloys, special sheets, welding wire, wire rope, copper and brass, tool steels and hacksaw blades.

M. W. Smith, who began with the Westinghouse Electric & Manufacturing Co. as a student engineer in 1915, has been appointed manager of engineering, according to an announcement by Dr. S. M. Kintner, vice-president of the organization. Mr. Smith has been continuously identified with the generator division since his first connection with the company. His headquarters will be in Pittsburgh.

The Lincoln Electric Co. recently moved their San Francisco office into new and larger quarters at 866 Folsom St., where ample facilities are provided for warehousing a complete line of arc welders, electrodes and supplies. L. P. Henderson, district manager, and S. H. Taylor, Pacific Coast manager, are located in the new building.

The Republic Steel Co., Cleveland, Ohio, announces several new distributors of their products. W. L. Blake Co., Portland, Me., and Hunter & Havens, Bridgeport, Conn., are now distributors of Toncan copper-molybdenum iron sheets, and the Jensen-Byrd Co., Spokane, Wash., have been appointed distributors of Enduro stainless steel.

W. A. Champieux, superintendent of the Illinois-Southern District of The Oxweld Railroad Service Co. since 1917, passed away on June 4, death being caused by a cerebral hemorrhage. Born in 1887 in Springfield, Mo., he entered the railroad service in 1902 with the St. Louis & San Francisco Railroad, later joining the Oxweld field organization. His headquarters were in Chicago.

The New York Welding Supply Co., 75 Grand St., New York, N. Y., have recently made additions to their sales and office force. They report more sales of arc welders in the first five months of this year than during the entire year of 1935. The company has issued a new catalog.

The Bastian-Blessing Co., Chicago, have added part of the states of Pennsylvania and New Jersey and the entire states of Delaware, Maryland and Virginia to their East-Central territory, which is under H. O. T. Ridlon, district manager.

TRY A WILL-WELD

A. C. WELDER

See The Difference!

NOT just a transformer—but a **WELDER**

NOT a boy trying to do a man's work, but a Man that can "take it"—easily—safely—economically—for 24 hours a day—six days a week—every week!

The difference? The combination of IMPEDANCE CONTROL, for automatic voltage control, and 50% oversize construction for long life and extreme economy of operation.

Four Sizes—8 to 400 Amperes

$130 to $400 F. O. B. Stock Point.

"Only Will-Weld Has Impedance Control"

Ask your jobber for a trial machine or write to

WILL-WELD MFG. CO.

INCORPORATED

OMAHA NEBR.

The Torchweld Equipment Co., Chicago, have taken on 3,000 sq. ft. of additional space in the building housing their plant at 1035 W. Lake St., made necessary by increased business.

Wm. T. Hampton, formerly with the Terre Haute Heavy Hardware Co., Terre Haute, Ind., has joined the Chicago sales force of C. E. Phillips & Co.

The Metallizing Co. of America, Inc., Los Angeles, Calif., have opened a branch office at 407 Call Building, San Francisco, under the management of E. T. Parkinson.

C. T. Price, vice-president of Compressed Industrial Gases, Inc., Chicago, Ill., recently returned from a month spent in Europe on a pleasure trip.

Notes From the Field

A body and fender repairman recently brought a fender to Charles Jones, R.R. 2, Dayton, Ohio, who operates a garage and welding shop, for welding some badly rusted-out pieces. Jones advised that the cost of repairs, plus solder-filling, would be more than the cost of a new fender, but the repairman told him to go ahead, since that was what his customer wanted. So the rusted places were welded, and then the body man continued with the solder-fill, filing and painting, and the owner gladly paid the cost, which was considerably more than the price of a new fender. Both Jones and the repairman are still trying to figure out why a welded and solder-filled fender is more desirable and superior to a new one.

Welding was used in making repairs on a large sand scow and gasoline pusher at the Government docks in Peoria, Ill., recently. The seams of the gasoline pusher were riveted and had jarred loose, but were soon made tight by welding. A complete new propeller shaft, rudder and exhaust pipe were installed on the scow, and several steel-plate bulkheads were cut out with the oxyacetylene torch and gusset plates were welded in. This reduced the weight of the boat about 900 lb., making possible greater speed and cutting fuel costs considerably. Welding was done by The Superior Welding Co., 331 Knoxville, Peoria.

Mike Melzer, who operates a welding shop at 3719 W. Third St., Dayton, Ohio, has specialized for several years in the building of equipment for amusement parks and carnivals. Such devices as small automobiles on tracks are produced by Mr. Melzer and sold to amusement concessions. Now he is engaged in the production of standard and special automobile trailers. Anything from a simple, two-wheel trailer to a de-luxe streamlined job may be purchased from Mike.

The Smith School of Welding has removed to larger quarters on the fifth floor of their present building address, 250 West 54th St., New York City. School quarters have been enlarged threefold and the number of welding booths substantially increased. Instruction is provided in gas and electric welding, with both day and evening sessions. W. R. Smith, in charge, reports a 30% increase in enrollment as compared with the corresponding period last year. An illustrated folder has just been issued describing the courses offered in detail.

The Santa Fe Trailer Manufacturing Co., 825 S. Santa Fe Ave., Los Angeles, Calif., specializing in all-welded truck trailers, recently opened for business. The concern has purchased the trademark of the "Custombilt" trailers and will use the same type of construction as was used by the Custombilt concern, which recently discontinued business. F. L. Young is owner, formerly being associated with the National Surety Co., on the Pacific coast.

The Marietta Manufacturing Co., Point Pleasant, W. Va., are putting the finishing touches to a number of inland-waterway and sea-going craft for several prominent shippers. Orders to be completed during June and July include three all-welded oil barges for export and four non-propelled all-welded steel tank barges for the Standard Oil Co. of New Jersey. The former are 150x30x7 ft., while the latter measure 175x35x8.6 feet.

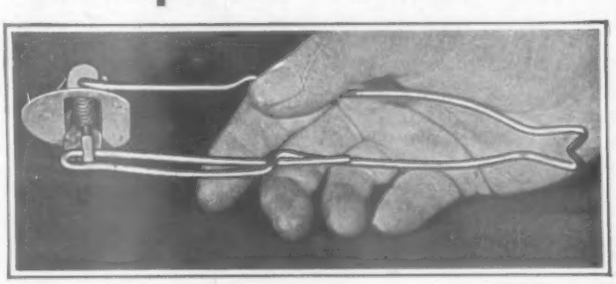
The repair of the teeth of two sprockets of a clamshell bucket, used in the construction of the South Adams St. viaduct in Peoria, Ill., is being undertaken by The Superior Welding Co., Peoria, Ill. These teeth are being built up and surfaced with self-hardening electrodes. The 15-ton steam hammer built up a short time ago with cast iron, is operating very successfully. The electric arc was used on this cast-iron job.

A saving of over $900 was made recently by the Beatrice Creamery Co., 219 Boush St., Norfolk, Va., when a steel patch was brazed in the bottom of the base of a 9x9-in. Frick ammonia compressor which had been burst by a broken connecting rod, thereby saving the cost of a new compressor. The patch, 18x20x3/8 in., was welded by the General Machine and Welding Corp., 817 Granby St., Norfolk.

The South African Institute of Welding, located in Johannesburg, has been "wound up" for lack of support, according to an announcement over the signature of J. W. H. Wilson, secretary. The Journal of the Institute has been suspended.

A new warehouse, with arc-welded framework, 44 ft. wide and 240 ft. long,

The Improved "Round File" Gas Lighter



Many superior design and construction features, found only in Improved "Round File," make this lighter the Welder's Favorite.

Hood forms a pocket for gas, insuring immediate ignition.
Larger file area, providing longer life for lighter.
Larger spark metal, which assures many additional ignitions.
Locking slip-on renewal cartridge, permits immediate replacement.
Cadmium plated, preventing rust.
Every part **thoroughly tested.**
Fully guaranteed.

Write for descriptive circulars and prices.

CAUTION: Imitations of the patented Improved "Round File" are on the market. For your protection insist on Safety Gas Lighter Co. patented lighters and genuine Safety Gas Lighter Co. renewals.

ORIGINATORS OF THE HAND GAS LIGHTERS **SAFETY GAS LIGHTER CO.** Est. 1901 **LYNN, MASS.**

is to be added to the plant of the Electro-Motive Corp., near LaGrange, Ill., to increase space for manufacturing operations in connection with the construction of Diesel-propelled lightweight railroad equipment. The Austin Co., who erected and welded the present plant, has the contract for the new building.

Erecting a building for the purpose of fabricating welded steel plate work, the only one of its kind in Virginia, is a recent achievement of the Norfolk Tank Corp., Hampton Blvd. and 25th St., Norfolk, Va. Five years ago this company employed five men, while today they have approximately sixty. H. H. Gary, president, states his business has increased 200% over 1934 figures.

The contract for installing two large water softeners and one large brine tank, at the Pere Marquette hotel, Peoria, Ill., has been awarded to Hagerty Bros., of that city. The sub-contract for the welding was awarded to The Peoria Welding Co. These tanks are to be installed in the second basement and must be assembled on the floor in separate pieces. The old tanks will be cut up and removed.

M. J. Joslen, of Long Beach, Calif., recently purchased the equipment and business of the Acme Welding Works, at 2748 North Cherry Avenue. Mr. Joslen was until recently employed by C. F. Braun & Co., fabricators of welded oil field specialty equipment, of Alhambra. The shop will continue under the name of the Acme Welding Works.

Welding a brake wheel on an unloading tower 150 ft. from the ground at the Smith-Douglass Fertilizer Co. plant, Money Point, Va., was recently completed by the Richard Machine Works, Inc., 307 South Main St., Berkeley, Va. At present this company is building several tankage cookers for the Smith-Rowland Fertilizer Co., Buell, Va. These are 6 ft. high and 14 ft. long.

Welding is being used in the laying of 12-in. underground steam heating mains for the Dayton Power & Light Co., in Dayton, Ohio, as extensions to the company's present underground heating system. The new mains will be tested hydrostatically at 1,000 lb. pressure. Jack Mason, of the American District Steam Co., is superintendent in charge of the work.

Steel sheeting for the roof of another rackhouse at Hiram Walker's Distillery, in Peoria, Ill., is on the grounds and will soon be tack welded on. The rackhouse, which is almost completed, has been bonded to the ninth floor, and whiskey has already been stored in all floors beneath this. When completed, this rackhouse will be ten or twelve stories high.

The Welded Products Co., of Bell, Calif., in the past few months has enlarged its manufacturing facilities. A new building has been erected and additional machinery installed to provide for efficient handling of the concern's increasing business.

The broken ears of the pulley wheels on the machinery at the Barrett Paper Mills in South Peoria, Ill., were repaired by oxyacetylene welding by the Superior Welding Co., 331 Knoxville, Peoria. They were of cast iron. Several set screws were also removed, some with the electric arc and some by hand. It took about a week to complete the work.

Lloyd C. Brown, proprietor of the Brown Welding Works, formerly located at 2416 E. 54th St., Huntington Park, Calif., has moved into new and larger quarters across the street at 2425 E. 54th St. Mr. Brown, in addition to general job shop welding, specializes in oil well draw-works units, digging-bit service and general drilling equipment.

During the early years of the depression, welded construction tended to give way to riveting, according to J. F. Minnotte, secretary of the Pittsburgh Section of the American Welding Society and member of the steel-erection firm of Minotte Brothers Co. But today, in his opinion, welded construction is more than coming into its own.

In the May issue of *The Welding Engineer*, an error was made in the address of Jack's Welding Shop, in Los Angeles, which was recently destroyed by fire. The addresses given were the reverse of their proper order, the correct new location being 6910½ S. Central Ave., instead of Hooper and Florence Ave., as stated.

Virginia's pioneer welding company, The Charles W. Gerloff Co., 430 Water St., Norfolk, Va., have just completed a very exacting arc-welding job in Loew's State Theater in Norfolk, on the air-conditioning condensers. Over 2600 ft. of extra-heavy 1¼-in. pipe was placed inside 2-in. pipe to form a gas jacket.

Edward Hernandez and Frank Barela are joint partners in a new welding shop recently opened for business at 4001 E. Ninth St., in Los Angeles. Mr. Hernandez was a welder for 15 years for the Southern Pacific Railway, and for the past three years operated a job welding shop at Tucson, Ariz.

The California Coach & Mfg. Co., featuring house trailers of all-welded steel chassis, recently opened for business at 1130 W. Broadway, Long Beach, which location is that formerly occupied by J. G. Hunt & Co. John Dunham and George Mesner are joint owners of the new concern.

The Dyrr Manufacturing Co., Huntington Park, Calif., manufacturers of farming implements, recently improved the facilities of their welding department in constructing additional booths

RYERSON *a dependable source for* WELDING ROD

Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types including both electric and gas rods are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment.

Write for Samples to Test

ELECTRODES

Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
Ryerson Shielded Arc Type No. 217
Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Ryerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

JOSEPH T. RYERSON & SON, INC.

Chicago. Milwaukee. St. Louis. Detroit. Cleveland. Cincinnati. Buffalo. Boston. Philadelphia. Jersey City

Why Engineers and Service Men Prefer

IMPERIAL

WELDING AND CUTTING TORCHES

THE durability built into all Imperial welding equipment is a guarantee of continued saving from year to year; replacement and maintenance costs are reduced to the minimum. This and the assurance of efficient service have made Imperial outfits a favorite wherever welding equipment is used.

A New and Serviceable Unit

TYPE 8X IMPERIAL WELDING TORCH

Light, yet rugged. Pure, hard-drawn copper tips, swedged type, each with individual mixer.

Type 8X, with 5 tips, wrench and 2 hose connections.....$27.50
Type 8X, with 3 tips, wrench and 2 hose connections..... 22.00

Order from your jobber. Write also for catalog to

IMPERIAL BRASS MFG. CO.

522 South Racine Avenue CHICAGO

WELDITE

Electrodes & Welding Rods

For General Purpose and Specific Uses such as

Pipe Welding
Tank Welding
Hard Surfacing
Cast Iron Welding
Heavy Plate Welding
Stainless Steel Welding

Weldite

Welding Rods Are Recommended for Either Gas or Arc Welding

Sold Exclusively Thru Distributors

A demonstration by our nearest Distributor will convince you of the quality and uniformity of our product.

CHICAGO STEEL & WIRE COMPANY

10257 Torrence Ave., Chicago, Ill.

MW

THE MARK OF SERVICE

A RECORD OF FIVE YEARS OF DEPRESSION

When the Machinery & Welder Corporation was formed in October, 1931, 800 sq. ft. of storage space was more than adequate to hold the complete stock of the company. Today over 11,000 sq. ft. of storage space at the five MW warehouses is required for the stock now carried for immediate delivery.

During this time the sales organization has grown from one to thirteen men —trained sales engineers to advise and cooperate with the hundreds of Machinery & Welder clients.

Peak inventory of the original MW warehouse on welding rods seldom reached 4,000 lbs. It requires over a quarter of a million lbs. of welding rod distributed among the five Machinery & Welder warehouses to be able to render the immediate delivery expected from this service organization.

We are grateful to those whose realization of the sincerity of purpose behind Machinery & Welder Corporation has made possible this "five years of depression" record.

ST. LOUIS
240 S. Boyle
CHICAGO
312 N. Sheldon
MILWAUKEE
2118 W. National
MOLINE
729 E. Third
KANSAS CITY
1705 Baltimore

ELECTRIC ARC • RESISTANCE • ACETYLENE • WELDING EQUIPMENT

Electrode Holders
Arc Welding Cables
Cable Connectors
Helmets
Handshields
Goggles
Respirators
Protective Glasses
Protective Clothing
Aprons, Gloves, Spats, Sleeves, Leggings.
Welding Hose and Connections.
Torch Lighters, Meters, Gauges.
Acetylene Generators.

MACHINERY AND WELDER CORPORATION

WE RENT WELDING EQUIPMENT

for arc welding, and have also purchased a new motor-driven welding unit.

Prow & Leffler, welding contractors of El Monte, Calif., recently completed the construction of 14 all-welded lion cages for exhibition purposes at the Pacific Exposition, at San Diego. The cages were built for Gay's Lion Farm, of El Monte.

The operator of a welding machine, and another man, received burns when a can of gasoline was ignited by sparks from a welding operation in the United Coach Co. plant at 1616 Grand Ave., Kansas City, Mo., on May 4th.

The city of Pittsburgh, Pa., is reported to have drawn up plans for the erection of a new all-welded steel bridge, the first to be built in the Steel City. Specifications for the structure are expected to be released shortly.

The Nashville Bridge Co., Nashville, Tenn., has just delivered a 43.9-ft. all-welded steel pusher boat to the United States Army Engineers headquarters at Pittsburgh, Pa., for use in inland-waterway service.

An unsually large amount of welding has been involved in steel-rail welding by the Dayton (Ohio) City Railway in extensive repairs on the company's West Third Street run, in the past few weeks.

The Body Brake & Fender Corp., 130 West Olney Road, Norfolk, Va., has been awarded contracts by both the Yellow Cab Co. and the Diamond Cab Co., of that city, to do all their welding work.

George Emanuels, well known Pacific coast steel man, is now manager of the Steel Fabricators Association, with offices in the Washington Bldg., at Th... and Spring Streets, Los Angeles.

Piper's Auto Body Co., 2324 Uni... Ave., Altoona, Pa., is now doing th... welding for the Bell Telephone Co., ... the Altoona district, having just re... ceived the contract.

New equipment has been installed b... the Weiler Welding Co., 410 East 2n... St., Dayton, Ohio, so they are now ab... to align wheels and straighten the axle... of automobiles.

Edward J. Maloney, a welding con... tractor of Detroit, Mich., died on Jun... 3 from injuries sustained in an accident. He was 46 years old.

The Acme Welding Co., Averyville, Ill., have completed the welding of a sheet-metal roof on a new schoolhouse at Chillicothe, Ill.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

ENGINE-DRIVEN ARC WELDERS

6 200-ampere; 12 300-ampere; 5 400-ampere; 6 600-ampere. 15 electric-motor-driven units, and 7000 ft. super-flexible rubber-covered welding cable. Address Jun-4, The Welding Engineer.

Welders—Three 300-ampere Lincoln, engine-driven; three 200-ampere Lincoln, engine-driven; four 220/440-volt, 200 and 300-400 ampere Lincoln, engine-driven. Other bargains. Service Co., 3741 Cedar Ave., Cleveland, Ohio.

Fly Ball Governors—Adapted to all makes of auto engines; belt driven, flat or V. Price, $6.50 prepaid. Satisfaction guaranteed. In ordering state style of belt. Wm. D. Alber, Beatrice, Nebr.

Bargains—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Ken's Exchange, Box U-661, Troy, Ohio.

HELP WANTED

Salesman—With good record, experienced in selling both oxyacetylene and arc equipment. Good job offered. Write, giving your complete history. H. O. T. Ridlon, 200 Park Ave. West, Mansfield, Ohio.

Local Salesmen—To sell high-grade A.C. arc-welding equipment on commission basis either through jobbers or direct. Address Jun-2, The Welding Engineer.

BUSINESS OPPORTUNITY

Metal-Spraying Business—Welding-shop owner with substantial business will lease or sell complete, established fast-growing metal-spraying department. Splendid opportunity for experienced young man. Tank Lining Co. of America, ... Academy St., Jersey City, N. J.

MISCELLANEOUS

Arc Welders—Build Your Own, saving $300 to $500. Complete instructions furnished. Easy pays-its-own-way terms. Investigate before you buy any welder. Hobart Welder Sales, Box U-462, Troy, Ohio.

POSITIONS WANTED

Sales Engineer—Technical graduate in electrical ... mechanical engineering with 15 years' experience with large organization in the electrical field, applying, selling and supervising to automotive, pump, crane, hoist, compressor, machine tool, textile and arc-welding customers. Desires change for more rapid advancement possibilities. Age 3... Address Jun-3, The Welding Engineer.

Welding Engineer—Graduate in welding and mechanical engineering desires position in the welding field or part connected with welding, as an engineer, inspector, production manager or in laboratory work. Experience includes design, detail, research, supervising and many years of practical work. Age 32 years. Address Jun-5, The Welding Engineer.

Welding Engineer—Experienced in design, welding of heavy and light gauge parts, structural work, hand and automatic welding, and successful in training men for quantity work and cost reduction. Now in Pittsburgh. Can accept short assignments anywhere. Address Jun-1, The Welding Engineer.